

**Effects of psychosocial stimulation on mental development of  
malnourished children attending Community Nutrition Centres of  
the Bangladesh Integrated Nutrition Programme**

**A Thesis submitted in fulfilment of the requirement  
for the Degree of Doctor of Philosophy  
of the University College London**

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2004**

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**“Regard man as a mine  
rich in gems of  
inestimable value.  
Education can, alone,  
cause it to reveal its treasures,  
and enable mankind to benefit therefrom.”**

**—Bahá'u'lláh,  
*Gleanings from the Writings of Bahá'u'lláh*, p. 260**

**Dedicated to my dear mother  
Mahbubeh  
who although left this physical world very early,  
has always been a source of inspiration to me  
to try and serve humanity.**

## **ABSTRACT**

This thesis concerns a randomised-controlled trial of the effects of adding psychosocial stimulation to the nutritional treatment of the malnourished children on their development and behaviour. The effect on their mothers' knowledge of parenting was also examined. Moderately and severely malnourished children attending 20 Community Nutrition Centres (CNC) of the Bangladesh Integrated Nutrition Programme (BINP) were enrolled in the study. Subsequently, the CNCs were randomly assigned to intervention and control groups and the malnourished children attending the intervention CNCs participated in an intervention for one year. Another group of adequately nourished children, matched for age ( $\pm 6$  months), gender and village was compared with the malnourished children.

Preceding the intervention, focus group discussions were held with rural mothers to determine their knowledge and attitudes about child development and the information was used in the design of the intervention. The intervened children were visited at home biweekly and then weekly and mothers attended weekly group meetings at the CNCs. The mothers were shown how to play with their child in such a way as to promote good development. They were also shown how to make toys from the waste materials.

On enrolment all children had their mental (MDI) and psychomotor (PDI) development assessed using the Revised Version of Bayley Scales of Infant Development (BSID-II). Their behaviour during the test was rated using Wolke's behaviour rating scale and mothers' knowledge of parenting, health, and hygiene was assessed. All children and mothers were re-evaluated at the end. The children's growth was monitored every three months throughout the study.



The intervention significantly benefited mental development of malnourished children and their behaviour compared with the control malnourished children. Their psychomotor development was not affected. The malnourished children came from poorer homes than the adequately nourished children. When socio-economic variables were controlled, the malnourished children initially had significantly poorer levels of psychomotor development than the adequately nourished children. There was no significant difference in their mental development or behaviour. By the end of the study the control malnourished children had significantly lower scores from the adequately nourished children in both their mental and motor development. They also had poorer behaviour. In contrast, the intervened malnourished children were not significantly different in mental development and behaviour from the adequately nourished children but remained behind them in motor development. The mothers of intervened children showed benefits from intervention in knowledge of child rearing.

Neither malnourished group improved in nutritional status during the year and the intervention had no effect on their nutritional status

It may be concluded that it is feasible to integrate child development activities into the nutrition services in Bangladesh and it is an effective means of improving the development of malnourished children.

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## **ACKNOWLEDGEMENTS**

First and foremost I would like to express my sincere gratitude to Prof. Sally Grantham-McGregor who with her outstanding knowledge, her honesty and dedication to the world of science and her motherly care has taught me more than what one may expect from a supervisor.

I am also grateful to my husband; Dr. Parviz Shahidi, my sons; Nabil and Naim, and my daughter; Shiva, who suffered the most during my studies but still, supported and encouraged me to complete the course.

My very special thank goes to Dr. Syed Nazmul Huda who supervised my work locally and was always available to help me with my problems.

I would also like to thank all the women and children who participated in the study, my colleagues at ICDDR,B who made it possible for me to attend the course and all the teachers and staff at the Institute of Child Health who were of much assistance.

I am also indebted to Bangladesh government authorities and to CARE-Bangladesh who allowed us to work in the Bangladesh Integrated Nutrition Programme (BINP)'s nutrition centres.

The project was jointly funded by the World Bank and the Department for International Development (DfID) and my tuition fees were sponsored by the latter. I remain grateful to both these Organisations.

Another very special thanks goes to all the staff who helped me with running the project without whose help it would not have been possible for me to carry out the task. They are Ms. Fahmida Khatun (Psychologist and trainer of the tester), Ms. Afrooza Parveen, Ms. Farhana Yasmin, and Ms. Fardina Mehrin, (testers), Ms.

Afrooza Hilaly Keya and Ms. Jesmin Akhtar (interviewers), Ms. Parveen Sultana Mita and Ms. Aklima Sardar (supervisors of play leaders), Mrs. Masuda Begum (cook), Ms Asma Begum, Ms. Rubia Akhtar, Ms. Khadija Akhtar, Ms. Shila Akhtar, Ms. Parveen Akhtar, and Ms Rani Akhtar (health workers), Ms. Umme Kulsum, Ms. Bilkis Begum, Ms. Jesmin Sultana, Ms. Rina Begum, Ms. Rima Akhtar, Ms. Lipi, Ms. Zakia Sultana, Ms. Begum Rokeya, Ms. Mafuza and Ms. Sufia Begum (play leaders), Mr. Abul-Kasem Mrida and Mr. Kabir (office assistants) and Ms. Sakila Yesmin who helped with final checking of the thesis. Finally I am grateful to my father Mr. Mansour and my sister, Dr. May Badii who have always been a source of encouragement to me.



Play Leaders and Health Workers who worked in the project are seen here in front of the local office at the closing ceremony of the project

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# **CHAPTER 1**

## **INTRODUCTION**

This thesis concerns the development of undernourished children in Bangladesh. It is well established that undernourished children usually have poor development both concurrently and in the long term. In this study we conducted a randomised controlled trial of adding psychosocial stimulation to the existing treatment of undernourished children who attended Community Nutrition Centres (CNC) of the Bangladesh Integrated Nutrition Programme (BINP) and determined the effects on the children's development. I will discuss the relevant literature below under the following headings:

- **Malnutrition**
- **Child development**
- **Review of literature on Early Childhood Development Programmes**
- **Review of literature on malnutrition and Child Development**
- **Review of literature on malnutrition and behaviour**
- **Vulnerable period**
- **Mechanism linking poor development to malnutrition**
- **Justification for the present study**

## **1.1. MALNUTRITION**

The term describes a wide range of clinical disorders ranging from severe protein-energy malnutrition (PEM) to obesity as well as the deficiency of many micronutrients required by the human body. Early childhood PEM is one of the most common forms of malnutrition in developing countries and is the focus of this thesis. In this chapter I will discuss the following:

- Growth
- Causes of PEM
- Diagnosis and classification of PEM
- Ecology of malnutrition
- Prevalence of malnutrition
- Bangladesh Integrated Nutrition Programme

### *Growth*

Growth may be defined as an increase in size or number of the cells of the body and is measured by weight, length/height, mid-upper arm, chest, abdomen, and head circumferences, tibial height, skin fold thickness, etc. In order to compare across countries the nutritional status of children is compared to reference data. World Health Organisation (WHO) recommended the use of the reference population (WHO 1983) defined by the US National Centre for Health Statistics (NCHS) (U.S. Food and Nutrition Board 1974) data, which has been adopted as a common reference for international use.

Growth monitoring of children has been promoted by the UNICEF to facilitate early detection of growth failure, its timely therapeutic intervention and planning possible preventive measures (Shrimpton et al. 2001)

### *Causes of PEM*

There are many causes of PEM. It may primarily be due to dietary deficiency in which case it is known as primary malnutrition or it may be due to illness when it is known as secondary malnutrition. However, both poor intake and infection frequently coincide. Common infectious diseases, which occur with PEM, are diarrhoeal diseases and helminthic infestation, respiratory infections, measles and

tuberculosis. PEM may also occur as a result of malabsorption due to diseases like celiac disease, tropical sprue, or cystic fibrosis. Certain metabolic disorders like diabetes mellitus and galactosemia have been found to cause malnutrition.

### *Diagnosis and classification of PEM*

PEM is not a single clinical entity but is characterized by growth failure. It is diagnosed by anthropometric measurements. There may also be a history of poor diet and feeding difficulties. In some cases signs may also be present such as wrinkled skin, sunken eyes, sparse hair, protuberant abdomen and apathy. Laboratory investigations may show the presence of low serum albumin and micronutrient deficiencies.

There have been many different classifications of PEM based on age, gender, height and weight measurements and presence or absence of oedema. I will describe three previously used ones then the one currently recommended by WHO.

1. Gomez and colleagues defined malnutrition on the basis of deficits in the weight-for-age of the children. First, second and third degree malnutrition are defined as 75-90%, 60-74% and less than 60% weight-for-age, of the NCHS median, respectively (Gomez et al 1956). However if oedema is present with any of the above classification it is considered as third degree malnutrition.
2. The Welcome classification of PEM was based on the presence or absence of oedema and weight-for-age expressed as a percent of the NCHS median. Children with weight-for-age less than 60% with or without oedema were classified as marasmic kwashiorkor or marasmus respectively, while those with weight-for-age between 60-80% with or without oedema were classified as Kwashiorkor or undernutrition respectively (Lancet 1970).
3. Waterlow et al considered height-for-age and weight-for-height as more useful tools for measuring the nutritional status of children as these take into account the height of the child. They suggested that low weight-for-height indicated acute malnutrition or wasting whereas low height-for-age indicated chronic or



for-height 80-90%, 70-89% and less than 70% of the median indicated acute malnutrition of grades I, II and III respectively. Children with height-for-age 90-95%, 85-89% and less than 85% of the median were classified as having chronic malnutrition of grades I, II and III respectively (Waterlow 1973). This classification was called a functional classification as it helps in planning interventions.

4. Building on the Waterlow classification it is now recommended by WHO to use z scores rather than percentages (de Onis and Blossner 2003;WHO 1981). The advantage of using z score is that any value has the same meaning for both weight and height, whereas a specific value of percentage of the median has a different meaning for different indicators. The z score also has similar meaning across the age range (WHO 1986).

Severe wasting or stunting are diagnosed when the z score is less than -3 and moderate when the z score is between -3 and -2. Weight for age is often used in clinic settings as it is easier to measure accurately and low weight for age is known as underweight.

#### *Ecology of malnutrition*

Ecology of malnutrition is a complex issue. A large number of studies have been published that try to determine biological, social, and economic characteristics that are associated with malnutrition. Broadly there are many conditions like poverty, working mothers, large family size, closely spaced pregnancies, low-birth-weight, etc. that are associated with malnutrition and often occur together.

These conditions are briefly discussed below.

**Poverty:** Malnutrition is known to be a disease of the poor. Growth stunting usually occurs in the families that are affected with poverty. (Brooks-Gunn and Duncan 1997). Families that have low income find it very difficult to provide nutritious diet for their children (Mishra and Retherford 2000;Bhat et al. 1997;Radebe et al. 1996;Saleh and El Sherif 1993;Dwivedi et al. 1992;Serdula 1988) and interventions that help to raise family income have shown positive impact on the nutritional status of the children (Range et al. 1997). Poor children's

impact on the nutritional status of the children (Range et al. 1997). Poor children's diet comes mostly from plant sources that are cheap and very little are obtained from animal sources that contain most of the essential ingredients for growth of the children (Hop 2003;Ayele and Peacock 2003) and families with severe financial deprivation have children who fail to thrive (Barbero and Shaheen 1967). Higher energy availability was found to be associated with lower prevalence of stunting worldwide (Frongillo et al. 1997). Children who are adequately nourished but from a poor family are called positive deviants and those who are malnourished but from more or less affluent families are called negative deviants (Zeitlin 1991). There are therefore, other conditions apart from poverty that may be accompanied with malnutrition. These conditions are discussed hereafter.

**1. Child's characteristics:**

- a. **Poor start:** Intra uterine growth retardation (IUGR) or prematurity result in low birth weight (LBW). LBW is defined as a birth weight <2500 gm while IUGR is defined as birth weight below the 10<sup>th</sup> percentile of the birth-weight-for-gestational-age reference curve (de Onis and Habicht 1996). There are almost 30 million LBW infants born every year. LBW children have a bad start. It is often difficult to feed them and they are more prone to infection. They have higher morbidity and mortality rates (Ashworth 1998) and those who survive have poorer growth than children who are born with a normal birth weight. LBW is one of the independent predictors of wasting in developing countries (Fernandez et al. 2002).
- b. **Diet:** Breast feeding for the first 6 months of life has proved to be beneficial for the child's nutritional status and those who are not fed colostrum or breast milk are at risk of developing malnutrition (Tumwine and Barugahare 2002;Owor et al. 2000;Saleh and Sherif 1993;Rao and Rajpathak 1992;Zeitlin 1991;Goodall 1979). Moreover children who receive early complementary feeding (Engle 2002;Range et al. 1997;Haider et al. 1996;Zeitlin 1991;Goodall 1979), delayed introduction of semisolid and solid food (Ghosh 2003;Engle 2002;Ghosh et al. 1976),

or inappropriately prepared formula milk (Egemen et al. 2002; Rao and Rajpathak 1992) suffer from some form of malnutrition.

- c. Age: The growth of many children begins to falter at about 3 months of age and growth faltering continues till around the 2<sup>nd</sup> half of the 2<sup>nd</sup> year of life, however, decline in length starts immediately after birth and continues till 3<sup>rd</sup> year of life (Shrimpton et al. 2001). In India highest rates of malnutrition were found in children aged 6-24 months (Khokhar et al. 2003) and prevalence of malnutrition increased with increasing age (Bhat et al. 1997).
- d. Morbidity: Children who suffer from repeated infections like diarrhoea (Vella et al. 1995; Saleh and Sherif 1993; Upadhyay et al. 1992), measles (Fernandez et al. 2002), worm infestations (Dwivedi et al. 1992) respiratory tract infections and other morbidities (de Onis and Blossner 2003; Dwivedi et al. 1992; Serdula 1988; Zeitlin et al. 1978) are more at risk of developing malnutrition. Malnutrition in turn makes the child prone to infections and therefore, leads to the vicious cycle of infection-malnutrition-infection. Children who are not immunized are at higher risk of malnutrition than those immunized (Frongillo et al. 1997; Owor et al. 2000; Dwivedi et al. 1992).
- e. Gender: In most developing countries girls are neglected relative to boys and traditionally are given less food and attention and medical care (Sachar et al. 1990; Ahmed et al. 1981). This results in a higher incidence of malnutrition and infection in girls than in boys (Bhat et al. 1997; Dwivedi et al. 1992). Differential treatment of children by gender was noted in a study of childcare practices in Bangladesh (Range et al. 1997) and positive deviance was observed three times more in male children than in female ones. In Bangladesh female children who came from landless families were significantly more stunted and undernourished than their male counterparts (Rousham 1996).
- f. Birth Order: Children with higher birth order are found to be at risk of malnutrition more than the lower birth order children (Jeyaseelan and Lakshman 1997; Bhat et al. 1997; Vella et al. 1995; Saleh and El Sherif 1993; Dwivedi et al. 1992; Lomperis 1991; Serdula 1988; Zeitlin et al.

the older children and therefore the younger ones who are at greater need of a nutritious diet during their early years of life are deprived of it.

2. Mother's characteristics:

- a. Education: Parental education has been found to be associated with children's nutritional status (Bhat et al. 1997) and maternal education and literacy is one of the most important factors associated with malnutrition (Frongillo et al. 1997). Mothers of malnourished children are usually less educated than those of the adequately nourished ones (Mishra and Retherford 2000; Jeyaseelan and Lakshman 1997; Vella et al. 1995; Guldán et al. 1993; Dwivedi et al. 1992; Serdula 1988; Zeitlin et al. 1978; Richardson 1974). Attempts to improve maternal literacy have shown promising results (Lomperis 1991). Maternal knowledge of weaning food (Brown et al. 1992; Rao and Rajpathak 1992) and her access to radio (Range et al. 1997) have been found to be key factors for development of positive deviance.
- b. Maternal employment: There is no clear-cut evidence as to whether children's nutritional status is improved or deteriorated by maternal employment. Extra earning by the mother may be used for more food for the family and mothers' contribution to family income was positively associated with children's nutritional status (Engle 1991; Lamontagne et al. 1998). At the same time it gives more authority to the mother to control the income and the affairs of the home (Radebe et al. 1996; Engle 1993). Studies have shown benefits to nutritional status following maternal employment even after controlling for other socio-economic backgrounds. However, there is always a trade-off between how much the mother earns and how much less time she spends in childcare (Popkin 1980). It is commonly found that mothers who have a low-paid job have to work for long hours in a day and do not get time to properly take care of their children or feed them. Childcare in the family is then provided usually by older siblings who may not be old enough to provide adequate childcare (Lamontagne et al. 1998). It is therefore the quality of childcare

childcare (Lamontagne et al. 1998). It is therefore the quality of childcare that a working mother is able to provide for her child, which affects the child's nutritional status (Engle 2002).

- c. Mother's age: In most developing countries, girls are to be married in their adolescence. Young mothers know very little about childcare and are usually less educated. The young age of the caretakers of children was found to be associated with severe malnutrition in Uganda (Owor et al. 2000;Serdula 1988)
- d. Maternal nutritional status: Malnourished mothers give birth to low birth weight children who in turn become malnourished later in life. Close association of LBW with wasting is sometimes noted as the intergenerational effect of PEM (Fernandez et al. 2002). It is the vicious cycle of malnourished girls giving birth to LBW children who if not properly treated will become malnourished and will have LBW children. Maternal nutritional status has been associated with malnutrition (Serdula 1988) and food supplementation during pregnancy has resulted in higher birth weight of the babies in some studies (Merialdi et al. 2003;Prentice et al. 1987;Klein et al. 1976).
- e. Mother's mental health: Maternal depression and dissatisfaction with her life are found to be associated with children's malnutrition (Zeitlin 1991). Mothers of malnourished children are usually more depressed, have lower levels of self-esteem and provide less stimulating environment for their children (Baker-Henningham et al. 2003;Range et al. 1997;de Miranda et al. 1996;Kerr et al. 1978).

### 3. Family characteristics:

- a. Family size and birth spacing: Large families with closely spaced children are usually more at risk of having malnourished children (Eckholm and Newland 1977) whereas smaller families have healthier children (Lomperis 1991). Families who have many young children find it difficult to provide all the necessities for them both due to economics and available time per child. In addition mothers who give birth to many children within a short span of time become malnourished and therefore

give birth to LBW children who are at risk of malnutrition (Dwivedi et al. 1992;Serdula 1988;Senanayake 1982)

- b. Unhygienic condition: Those who live in less hygienic conditions are at risk of being exposed to more infectious agents, which in turn increases morbidity and results in more malnutrition. Safe access to water supply (Fernandez et al. 2002) and hygiene practices (Range et al. 1997) were found to be important factors for positive deviance in child nutrition. Washing children's hands (Lamontagne et al. 1998) and adopting cleanliness habits (Ahmed et al. 1993) were associated with lower prevalence of malnutrition.
- c. Traditional and religious beliefs: Social and cultural taboos, customs, practices, superstitions that are deeply rooted in the culture of some countries, may be harmful for the growth of the children (Engle 2002;Sivaramakrishnan and Patel 1993). For instance pregnant mothers are not allowed to eat much as it is believed that if they eat more than a certain amount, the child grows very big and delivery will be difficult. This results in LBW children. There are others who think if the child is sick, breast feeding is harmful and they keep the child on a very low calorie, unhygienically prepared diet which results in less immunity to combat infection, less intake of nutritious food and more exposure to infectious agents. Many believe that colostrum is harmful and therefore discard it, while many mothers believe that feeding undiluted milk or semisolid food will cause diarrhoea (Hasan et al. 1991).
- d. Psychosocial deprivation: Children who are deprived of their mothers' attachment and bonding suffer growth failure (Frank and Zeisel 1988;Elmer 1960). Maternal care and stimulation seem to have a substantial effect on the growth of children and 'adequate mothering' was shown to protect the children from malnutrition even when diet was not sufficient (Hepner and Maiden 1971). Goodall narrates how in the 13<sup>th</sup> century Frederick II had a few newborn babies brought up in absolute silence in an attempt to discover how language is naturally developed. It was found that all those infants failed to thrive and subsequently died having been deprived of the loving words of their carers (Goodall 1979).

Children who suffer from psychosocial deprivation show significant improvement once they are provided an appropriate stimulating environment (Barbero and Shaheen 1967). An intervention programme to improve mother-infant interaction has also shown improvement in children's growth (Cooper et al. 2002).

- e. Substance abuse: Use of tobacco, opiates, marijuana and alcohol during pregnancy has been shown to result in intra uterine growth retardation and subsequent LBW (Bennett 1999) and malnutrition of the infants (Strauss 1997). In some studies paternal smoking, alcoholism, and use of psychoactive substances were found to have deleterious effects on children's birth weight and length (Frank et al. 2002).
- f. Status of women: In most Asian countries, women are considered as inferior members of the family and therefore less attention is paid to their health and nutritional status resulting in more malnutrition of girls and women. In addition to being more malnourished, being treated in an inferior manner affects their self-esteem and their child rearing practices (Engle 2002).

- 4. Global: Political, environmental, and ecological conditions like wars, famines, floods, instability in the economy; all result in deterioration of health of the population and children who are the most vulnerable group are generally most affected.

#### *Prevalence of malnutrition*

##### Global

According to a UNICEF report in 2001, globally there were 28% underweight, 10% moderately or severely wasted and 32% moderately or severely stunted children under 5 years of age (UNICEF 2001). By the year 2002 although malnutrition declined by 17%, it still accounts for 149 million children in the world, two thirds of whom live in Asia (UNICEF 2002). The UNICEF report of 2004 indicated that by 2002 the global figures for underweight, wasting and stunting were 27, 10 and 31% respectively (UNICEF 2004).

### Situation in South Asia

Figures for the prevalence of moderately or severely underweight, wasting and stunting in South Asia were 49, 17, and 48% respectively in 2000 (UNICEF 2001). There was a very small decrease subsequently and the prevalence of moderate or severe underweight, wasting and stunting was 46, 17, and 45% respectively in 2001 (UNICEF 2003) and 46, 15, and 44% respectively in 2002 (UNICEF 2004).

### Situation in Bangladesh

Bangladesh is one of the world's poorest and most densely populated countries. It has a population of over 120 million people with a GNP per capita of US\$370 and adult literacy rate of 63% and 48% for males and females respectively. In 2000, 30% of the children were born with low birth weight (<2500 grams) and 53% were exclusively breast fed for 3 months (UNICEF 2004). Fifty six percent of children under 5 years suffered from moderate or severe underweight (weight-for-age <-2sd), 18% from wasting (weight-for-height <-2sd) and 55% from stunting (height-for-age <-2sd) (UNICEF 2001). However, there has been a recent improvement and malnutrition declined to 48, 10 and 45% for underweight, wasting and stunting respectively in the year 2002 (UNICEF 2004).

### *Bangladesh Integrated Nutrition Programme (BINP)*

The BINP is being implemented by the Bangladesh government under its Ministry of Health and Family Welfare. The aims are to develop a comprehensive national nutrition programme whereby the prevalence of malnutrition particularly in women and children is reduced. This programme uses measures like ensuring household food security, changing food related behaviours and caring practices, growth monitoring, supplementing infants, pregnant and nursing mothers, and many other means to achieve its goal.

The project is financed by the World Bank and the Government of Bangladesh and is implemented with the help of 5 Non-Government Organizations (NGO). UNICEF has been providing technical support since the planning stage of the programme.

Direct beneficiaries of the programme are children below two years of age, pregnant and lactating women who have access to the core component of the



programme; Community Based Nutrition Component (CBNC). Nutritional status of all children below two years of age, pregnant women in their first trimester of pregnancy, and lactating women is determined by monthly growth monitoring at the CNCs by Community Nutrition Promoters (CNP). Children found to be severely malnourished or those who show no increment in their weight on 3 consecutive months, and pregnant and lactating women who have a body mass index (BMI) of <18.5 are eligible for enrolment.

The programme started in November 1996 and is being implemented by phase in 59 rural Upazilas (Unions). It covers a total population of 14,828,961, who have access to 13,395 CNCs. There are 701,959 children under 2 years of age, 153,232 pregnant women and 178,379 lactating mothers enrolled under the programme.

## 1.2. CHILD DEVELOPMENT

Development is defined by Holt as 'a process of unfolding, expanding, becoming fuller, more complex and more complete' (Holt 1991). It is defined in a simpler term by Myers as 'a process of change in which the child learns to handle ever more complex levels of moving, thinking, feeling, and relating to others (Myers 1995).

### *Characteristics of child development*

Development can be viewed as a process with several characteristics:

#### 1. Development is patterned, but unique

There is a general sequence or outline to development but the rate, character and quality of development differ from child to child. It follows a definite ongoing process beginning with embryogenesis, is closely linked to maturation of the central nervous system (CNS), and follows a cephalo-caudal pattern (Gesell 1966).

#### 2. It is a multidimensional process

There are several important dimensions to development including physical or motor, language, cognitive, social and emotional.

The physical or *motor* dimension of development is the ability of the individual to move and co-ordinate. The motor development is an important dimension of development as it gives the child a chance to explore the environment. When a child is able to move around s/he adds to her/his learning experience by interacting with the environment and develops further. The motor skills include gross motor and fine motor functions. The pattern of motor development is cephalo-caudal. Gross motor functions are the movements of the large muscles and include neck control, rolling, sitting, crawling, standing, walking, running, jumping etc. Fine motor, i.e. the movements of the fingers involves use of the finger in grasping, reaching for and manipulating objects, writing, etc.

The *communication or language* is another dimension to development. Language is receptive and expressive in nature. The receptive language is when a child understands what is said to her/him. This occurs before the development of

expressive language, which is when the child can express her/himself either by language or by other gestures. To develop language the child requires to be able to hear and at the same time needs to listen to a wide range of sounds and participate in conversation.

The mental or *cognitive* dimension is the ability to think and reason. Cognition relates to mental abilities and includes memory, thinking, problem-solving, reasoning, etc. Cognition theory was described by the Swiss zoologist and psychologist, Jean Piaget to have 4 stages. The first is the stage of *sensorimotor development*, which occurs from birth to 2 years of age. In this stage the child learns through sensory experiences and motor activities. During this stage the infant's development takes a circular shape as described by Piaget which means that the child initiates an activity which gives her/him pleasure and by acquiring the knowledge that this activity is pleasurable s/he initiates further activities (Sternberg 2002). The next stage is the stage of *preoperational thought*, which lasts from 2-6 years. In this stage the child cannot understand other people or children's viewpoint and sees everything related to her/himself. The third stage is the stage of *concrete operational thought* in which the child adds new concepts to her/his thinking process like mathematics, reading, classification, and improved verbal skills. This stage continues from 6-12 years. The last stage described by Piaget is the stage of *formal operational thought* which occurs from 12 years and beyond and is the stage when the child begins to create and use new ideas and use abstract reasoning (Pollak 1993). There are other definitions of cognitive theories, which are beyond the capacity of this thesis and are not discussed here.

The ability to relate to others is the *social* dimension of development and includes self-help skills and doing more independent functions in life. The child is embedded in a large network of people and learns to interact with them in different ways. The smallest and most important segment of this network is the family, then comes friends, neighbours, acquaintances and even strangers. The largest segment of this network is the culture into which the child is born (Lewis 2002a).

The ability to feel and control one's emotion is the *emotional* dimension. In the newborn infant a narrow range of emotional behaviour is observed. By three months joy and sadness are fully developed in the infant. For example when mother sits in front of the infant and plays with him/her, smiling and even laughing can be heard while if she ignores the child and turns away from her/him the child becomes upset and even cries. By six months emotions like surprise, interest, disgust, anger and fear are developed and by about the middle of second year consciousness emerges. By around the middle of the third year that is at about two and a half years of age the child develops self-consciousness and that means the child is able to use societal standards and rules. Most of the emotional development of the child is completed by three years of age (Lewis 2002b). The emotional warmth and consistency of the relationship with the primary caregiver is important to the child's emotional development and determines the quality of attachment. Children develop attachment to the primary caregiver; usually mother during the first 6 months of life (Bendersky 2002). Attachment was described by Bowlby (1982) as the feeling of security that the infant seeks when stressed. A secure child is defined as one who after a period of separation from mother shows little resistance to being comforted and calms easily on being reunited. On the other hand an insecure child may be avoidant or ambivalent. The avoidant child is one who after separation from mother may not become distressed and does not seek to contact mother when she returns. The ambivalent child wants to contact mother but remains upset even after being reunited with her (Bendersky 2002).

### 3. Development is an *integral* process

The above mentioned dimensions are interrelated and must be considered together, changes in one may affect the others for example if a child is under emotional stress the ability to develop physically and mentally will both be affected. Or if children have poor physical development and poor motor function they will be less capable of exploring the environment and developing their cognitive abilities.

#### 4. Development is a continuous process

Human development starts in the womb of mother and continues throughout life. What occurs in early life may affect development at later time. Conversely, events in later life may modify the effects of the early environment.

#### 5. Development is modified by many factors

The child's genetic potential is modified by many factors including health, nutrition, and the quality of the environment.

##### Health

Various types of childhood infections are associated with cognitive impairments. The mechanism by which they affect function has not been thoroughly studied. There are several possible ways, for example general malaise and apathy as a result of illness may affect children's abilities to explore the environment and acquire skills. Another possibility is hearing loss can occur from repeated ear infection and visual impairment may be caused by eye infections (Sternberg 1997). It is also well known that repeated infections may result in undernutrition (Keusch 1990) and iron-deficiency anaemia (Olivares et al. 1999) which may in turn cause developmental delay (Grantham-McGregor 1995; Grantham-McGregor and Ani 2001).

##### Nutrition

The effect of undernutrition will be discussed in more detail in chapter 1.4.

##### Environment

The environment in which the child lives affects the child's mental development. Wachs discusses the proximal and distal environmental factors that affect children's development in detail (Wachs 2000) and I will give a brief outline here.

##### *Proximal environmental factors*

Proximal environmental factors are those that directly impinge on the child. These include transactions between the child and parents, other children, and other adults like teachers, relatives, and neighbours. Other factors like the physical

characteristics of the immediate environment are also included as the proximal environmental factors. For example presence and variety of toys and other objects to which the child is exposed, the cleanliness of the home, the noise level, overcrowding in the home, frequent changes in the child's environment, and the lack of temporal and physical structuring in the home all affect the development of the child. Parental beliefs, rearing style, values, and goals also influence development; for example some parents believe they can influence their child's development while others assume that children's development is due to intrinsic factors like genes and biological maturation, and that they can not influence their child's development. Their behaviour towards their children's development is thus affected by such beliefs. Parental rearing style such as authoritative versus authoritarian rearing also affects the children's development. Parents can even influence their children on the choice of their peer-group, which in turn can affect the future development of the child. For example antisocial behaviour has been observed in children who have high levels of interaction with delinquent peers (Wachs 2000).

#### *Distal environmental factors*

Distal environmental characteristics are those external factors that either influence or structure the proximal environment or they moderate the nature of the proximal environment. These include birth order of the child, the cultural or social institutions like school or social class. For example the birth order of the child does not have any direct impact on the child but it affects how the parents behave with the child. It is to be noted here that environmental influences are bi-directional in nature. For example the effects of poverty, social violence or other environmental stressors can be negated through a caring, supportive and responsive family environment but on the other hand overcrowding in the home erodes the social support level of the individual (Wachs 2000).

### *Multiple risk factors*

Many environmental risk factors often occur together and have cumulative effect over time. For example a malnourished child usually lives in a poorer environment, has less educated and caring parents, fewer toys or playing opportunities and is more at risk of being sick. Nutritional deficiency and poorer access to a stimulating environment may result in a passive child with no intention of relating to the environment (Strupp and Levitsky 1995).

The effect of subsequent environment in modifying the effect of PEM is clearly seen in studies of adopted children. The Korean children adopted by American families improved in their nutritional and developmental status after a minimum of six years (Winick et al. 1975). Similarly Romanian children adopted by British families before 6 months of age caught up with the children adopted within UK after 4 years of being adopted although they were physically and developmentally behind the UK adoptees at the time of adoption (Rutter 1998). Colombo et al. compared children with similar history of malnutrition who were either adopted by middle and high socio-economic families, were institutionalised, or returned to their biological families. The children, who were adopted, and experienced better environmental and emotional conditions developed significantly better than the other two groups (Colombo et al. 1992). And again Indian children adopted by Swedish families reached similar developmental levels to that of Swedish children after 2 years of being adopted (Proos et al. 1992). Studies of children who became malnourished due to non-nutritional causes like cystic fibrosis (Ellis and Hill 1975) and intestinal diseases (Beardslee et al. 1982) but who were raised in supportive homes showed no significant differences from the adequately nourished control groups in their IQ.

### *How factors influence development*

Factors influencing early development can moderate the impact of later development by ways of sensitisation, steeling and blunting (Wachs 1999). *Sensitisation* is when an early experience makes the individual more sensitive to a later stressor. For example the children malnourished in early childhood were more sensitive to hunger at school age than adequately nourished children (Pollitt et al. 1998; Simeon and Grantham-McGregor 1989). On the other hand *steeling* is when

the early influences protect the child from later untoward experiences while *blunting* is when the early exposure to risk factors reduces the individual's ability to benefit from future developmental opportunities (Wachs 1999). An example of steeling is children who are more securely attached in early childhood show more competence in handling the environmental challenges than those who are insecurely attached. An example of blunting is the poorer response of malnourished children to improved nutritional and environmental conditions compared to better nourished children (Lien et al. 1977; Winick et al. 1975).

Child development is a complex process affected by many factors operating in different ways over time.



### 1.3. REVIEW OF LITERATURE ON EARLY CHILDHOOD DEVELOPMENT PROGRAMMES

#### *Justification of early childhood development programmes*

In recent years, there has been a marked decline in infant mortality rates in the developing countries. It is reported that the survival rate of the children in 1960 was 83% globally whereas it improved to 92% by 1991 (Myers 1995). Under-5 mortality rate dropped from 196 in 1960 to 82 in 2002 globally (UNICEF 2004). However, highest mortality occurs in developing countries and the least developed countries have the highest figures. The figures for the under-5 mortality in different parts of the world are given in the table below:

**Table 1.3.1.**  
**Regional Summaries of under-5 mortality rate (UNICEF 2004)**

Under-5 mortality	1960	2002
Sub-Saharan Africa	262	174
Middle East and North Africa	250	58
South Asia	244	97
East Asia and Pacific	207	43
Latin America and Caribbean	153	34
CEE/CIS and Baltic States	112	41
Industrialized Countries	39	7
Developing Countries	222	90
<b>Least Developed Countries</b>	<b>278</b>	<b>158</b>
World	196	82

Under-5 mortality rate is defined as the probability of dying between birth and exactly five years of age expressed per 1000 live births.

As more children survive, attention is increasingly being focused on their quality of life. Large numbers of children are still living in poverty with poor health and nutrition. These factors, along with the poor quality of stimulation in the home have a detrimental effect on children's development. Consequently, an enormous number of children fail to benefit fully from schooling, and fail to achieve

adequate levels of education. They subsequently face difficulties in finding an employment or take low paid occupations. Poorly educated parents tend to have larger numbers of children with poorer health, nutrition, and cognitive development thereby maintaining the “poverty cycle”. Where large numbers of children have poor development, resources invested in their education are under-realised and national development is likely to be seriously affected. There is therefore an increasing interest in programmes of early child development aimed at promoting better development of the increasing numbers of surviving children rather just at survival itself.

#### *Target population:*

The programmes of early childhood development have mostly targeted high-risk children. There are two categories of high-risk children; those who suffer biological/physical problems i.e. low-birth-weight, prematurity, or malnutrition, and those who live in disadvantaged environments like poverty, low parental education/IQ, single parents, parental drug abuse, history of child abuse, and/or lack of psychosocial stimulation at home. In many developing countries these two categories overlap and children suffer from both biological problems as well as live in disadvantaged homes. Some programmes aim at improving the development of biologically affected children, some target environmentally at-risk children, while others opt for an integrated approach.

#### *Types of the programme:*

The programmes of early childhood stimulation have used different approaches some focusing specifically on parents while some others pay more emphasis on the children.

Sometimes there are joint-focused programmes with a high focus on parent and child and on the contrary some programmes are of low intensity with a low focus on both parent and child (WHO 1999a). The child-focused programmes are mostly centre-based in which the child is brought from the home to a centre or other

homes and is given intensive psychosocial stimulation. These programmes are most common in the developed countries where resources are relatively abundant and usually involve children three years and above although a few small programmes provide centre-based intervention to children in their early months of life. The parent-focused programmes are usually home-based where a visitor goes to the homes and spends time with parents; mostly the mother but may be other carers. These programmes mainly involve parents of younger children, although exceptions can be found where parents of older children have also been taught to improve their children's school readiness.

Numerous Early Childhood Care and Development (ECCD) Programmes have been conducted in many countries, however published evaluations are mostly from the United States of America (USA) and there are relatively few evaluations from other developed and developing countries. These programmes conducted mainly in developed countries targeted disadvantaged children with the aim of improving their IQ and school achievement. Most programmes however were designed for service and not for rigorous evaluation and in general only some model programmes that were developed by researchers evaluated the effects of such programmes using a randomised controlled trial (RCT) design. Some large-scale programmes used matched comparisons or controlled for differences on important characteristics and therefore lack the strength of a RCT in which at the beginning of the programme children are assigned to the experimental or control group randomly.

Since there are an enormous number of studies of ECCD programmes, for the sake of brevity this review will be limited to a few selected studies of the developed and developing world. I have selected the better-designed and well-known research studies that have a good follow-up, and the studies are discussed according to the location of the programme as follows:

1. Programmes in USA; centre-based, home visiting and joint-focused
2. Programmes in other developed countries
3. Programmes in developing countries
  - Large-scale programmes
  - Experimental studies

### **1.3.1. Programmes in USA**

#### **a) *Centre-based programmes***

One of the most extensive reviews of ECCD programmes was conducted by Barnett. He reviewed 36 programmes of ECCD in the USA (Barnett 1995) based on selection criteria of

- a) Serving disadvantaged children,
- b) Having a comparison group similar to the participating children,
- c) Starting the programme at or before age 4, and
- d) Following them at least to 8 years of age for one or more aspect of cognitive development, school progress and socialization.

He found 15 model programmes specially designed for research purpose and 21 large-scale public programmes. Most (30) of these programmes served children 3 years and above and 34 used centre-based activities. He concluded that many of these programmes produced short-term benefits on children's Intelligence Quotient (IQ) but there was often a decline in children's IQ after entering the school. Thirty two assessed school achievement after the children were 8 years of age and 15 found some benefit. Long-term effects on grade retention, placement in special education and social adjustment were assessed in 25 programmes in adolescence or early adult life and nearly all (22) of them found benefits.

A report from the Consortium for Longitudinal Studies showed a significant impact on placement in special education, grade retention, high school graduation achievement in maths and reading when the recipients of early education projects were followed up at 9-19 and 12-22 years of age (Haskins 1989).

#### ***Head start programme***

The most well established centre-based child-focused interventions is probably Head start; a large-scale programme in USA sponsored by the government, which began in 1965, aiming to prepare children from poor families to enter school. It has a diverse programme covering education, health, social services and parent involvement. In 1994 it served over 740,000 children enrolling 37% of the eligible population (Head Start 1995). A review of 16 studies that evaluated the programme

in different parts of the country found significant improvement in the participants in IQ scores compared to control children who did not attend the programme, but the improvement washed out within the first 2 or 3 years of schooling (Barnett 1995). Some positive effects were noted when children were followed up to early or late adolescence. All but one of the model programme studies looked at school success and found lower rates for grade retention and special education in the children who received the programme. However, in only five out of 14, statistically significant effects on reduction either in grade retention or a need for special education was observed (Barnett 1995). Among the large-scale programmes, 8 out of 10 studies that looked at the grade retention and special education found significant benefit of the programme. Out of the three model programmes and two large-scale programme studies with long follow-up, all found large effects on high school graduation rates but only three that had larger sample sizes showed statistically significant effects (Barnett 1995). However, none of the studies were randomised and some had high attrition, and therefore it is very difficult to conclude with certainty if the results were due solely to intervention or other contributing factors existed.

The *Abecedarian project* was a well-designed centre-based programme with a long-term follow-up till the participants were 21 years old. This programme worked with 111 children from 109 poor families aged 6 weeks to 3 months at the beginning of the study. These children were randomly assigned to control and intervention. All the children were found to be at high risk according to maternal education and family income. They were 5 years old at the end of the intervention, which was a full time participation of 10 hours a day, 5 days a week and 50 weeks per year. Intervention was of a high quality with low teacher:child ratios and comprised of an infant curriculum aimed at improving cognitive, language, perceptual-motor, and social development and a curriculum for preschool children more focused on language development and preliteracy skills. In addition the intervened infants received nutritional supplements at the centre and the control infants were supplied with iron-fortified formula for the first 15 months. All the families were provided with social work services. There were many children in the control group who received other childcare facilities either in infancy or at

preschool years. Results showed that at 6 and 12 months of age there was no significant difference in their development, but from 18 months onwards significant effects of high quality intervention were observed in most of the developmental measurements. Assessments up to 54 months of age continued to show benefits (Ramey and Campbell 1984). The lack of any significant effect at 6 and 12 months of age is not disappointing as such ' sleeper effects ' have also been noted in other studies where the positive effects of intervention was only found after the intervention was stopped for a few years (Achenbach et al. 1993). The subjects were again tested for development and academic achievements at 5, 6.5, 8, 12, 15, and 21 years of age. It was noted that the individuals in the treatment group scored consistently higher than the control group on both cognition and academic achievements even at 21 years of age. It was also observed that the IQ scores mediated the effects of treatment on maths and reading achievements (Campbell et al. 2001). The authors concluded, *"Intensive early childhood education can have long lasting effects on cognitive and academic development"*. The study had a low attrition rate and at the age of 21 years 104 out of the original 111 were tested. The randomised design of the study and the low attrition rate make it more reliable to draw conclusions from this study.

#### *Summary of centre-based programmes*

Of the two programmes described in detail, only the small Abecedarian project had a randomised design (Campbell et al. 2001). Head Start was set up as a programme and although its evaluation has shown positive short-term effects on IQ of the children and long-term effects in class retention and special education (Barnett 1995) the evaluations have not been based on random selection and they often lacked pre-test measurements. The Abecedarian project was a well-designed project, had a strong randomised design and low attrition rate even up to age 21 years. The programme has shown promising results (Campbell et al. 2001) but it was a high intensity programme conducted using professionals with prolonged contact time and would have been extremely expensive.

However, from the reviews of the topic (Barnet 1995;Haskins 1989), it is clear that good quality centre-based based care usually brings at least short-term benefits to disadvantaged children. Carefully evaluated good quality research interventions

have also shown important long-term benefits (Haskins 1989). The expense of centre-based programmes is a matter of concern when designing programmes for low-income countries.

*b) Home visiting programmes (table 1.3.2.):*

There are fewer home visiting programmes and most evaluated ones were conducted in USA and the ones discussed here were chosen based on the selection criteria mentioned above.

In a review of home visiting programmes Gomby mentions 6 programmes that were evaluated adequately through randomised trials namely; The Nurse Home Visitation Programme (NHVP), Hawaii's Healthy Start, Parents as Teachers (PAT), The Home Instruction Programme for Preschool Youngsters (HIPPY), The Comprehensive Child Development Programme (CCDP), and Healthy Families America (HFA) (Gomby et al. 1999). It was concluded that the home visiting programmes did not show consistent benefits in the areas of child health and development.

*Nurse Home Visitation Programme* was established in 1977 and consisted of nurses visiting first time pregnant women, who were also poor. They were visited in their homes during pregnancy and the first 2 years of their child's life. The programme is aimed to improve pregnancy outcome, child health and development and families' self-sufficiency. The visits last between 75 and 90 minutes and vary from weekly to two-weekly depending on the phase of the programme and the necessity of having more visits as recognised by the nurses (Olds 1999). Olds summarised the results of two randomised trials that evaluated the programme in New York and Tennessee. In Elmira, New York 400 women were randomly assigned to 4 groups. Group 1 received sensory and developmental screening for children at 12 and 24 months. Group 2 in addition to the above also received free transportation for prenatal and well-child care through 24 months. Group 3 received all that group 2 got plus home visits by nurse during pregnancy and in group 4 in addition to all that was received by group 3 mothers, the visits were extended until child's second birthday. In Memphis, Tennessee a larger sample of 1139 were selected and randomly assigned to 4 groups with minor differences.

Group 1 received only free transportation for prenatal care appointments and in group 2 developmental screening and referral services for children at 6, 12, and 24 months was added. Group 3 received the above plus home visits during pregnancy and 2 visits after the child's birth. And in group 4 the same services were provided until child's second birthday. Results at age 4 in Elmira showed that overall; there was no effect of the programme on children's development. However, the investigators tried to look at the effects of the programme in high-risk children. They did not find any difference in mental development of the children born to low-income unmarried teen-age mothers but when the participants were grouped according to mothers' smoking habits, children of mothers who were moderate or heavy smokers and who received nurse visits had better cognitive development than the control group. On the contrary, the children in the comparison group whose mothers were moderate or heavy smokers showed a decline in their development after two years and it was concluded that the programme prevented this decline in this high-risk group (Fig. 1.3.1.).

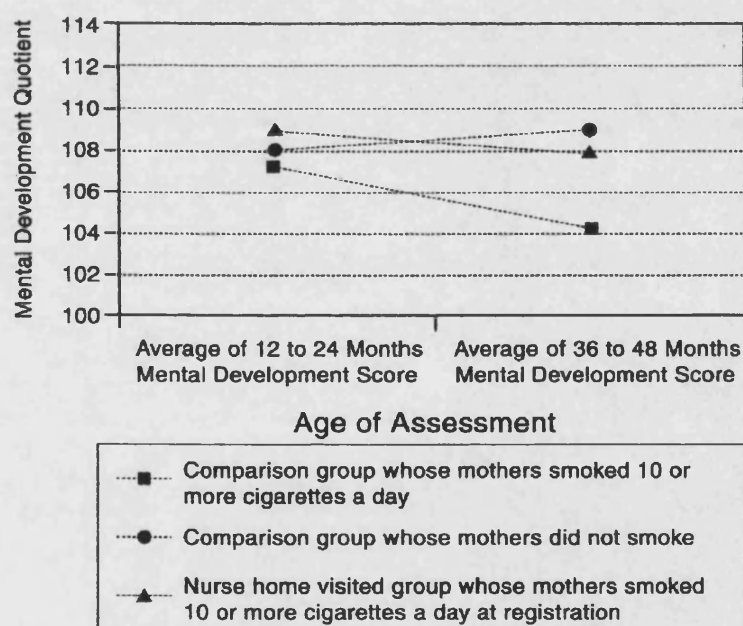


Figure 1.3.1. Mental development of children during first four years of life whose mothers smoked 10 or more cigarettes per day during pregnancy at registration and those whose mothers did not smoke.

Source: Olds et al. 1994



In the Memphis project there was no difference in cognitive development and behaviour of the children at age 2 i.e. after the programme had ended. At the follow-up of the Elmira study when the children were 15 years of age, 81% of the original sample was found. No group difference was noted for the whole sample but children in the neediest families i.e. those of the low-income unmarried women, in group 4 had fewer arrests and convictions, smoked and drank less, had less criminal activities and fewer lifetime sex partners. The programme in both the places had some impact on reducing dysfunctional childcare and improving maternal life course (Olds et al, 1999) and this may further contribute to better environment for the children. The fact that the population most at risk benefited whereas the others did not, suggests that in future such programmes should be targeted only to very high-risk families.

*Hawaii's Healthy Start Programme* operates in Hawaii and aims to improve child health and development as well as prevent child abuse and neglect, in families that are at risk of poor child outcomes. The programme initially began in one site in 1975 but expanded to 14 sites in Hawaii. It operated by first identifying the families with newborns at risk of child abuse and neglect and then helping the family members to cope with the challenges of child rearing through home visits by trained paraprofessional. It was initially started as a programme without plans for its evaluation. Later a pilot study was conducted to assess the effectiveness of the programme, which showed some improvements in reducing child abuse and neglect, but there was no control group and it was not possible to attribute the improvements to the programme itself. The authorities therefore launched an evaluation study with a strong scientific method to supply a solid evidence for the model's effectiveness. The evaluation was conducted by three agencies in six programme sites in which the families that were identified as at risk families were randomly assigned to a home visiting and a control group. The study had a high attrition rate and at the end of the 1<sup>st</sup> year only 49% were still active in the programme. The evaluation failed to show benefits of the programme in mothers life course and children's health and development status at 1<sup>st</sup> and 2<sup>nd</sup> year's follow up. However, mothers in the programme used more frequent non-violent discipline methods than the control mothers. When agencies were evaluated separately, the

methods than the control mothers. When agencies were evaluated separately, the result differed among the three agencies and some showed improvements in some outcome variables, whereas others did not (Duggan et al. 1999). It seems that though the method used by all the agencies were similar, some implemented the programme differently and had different results. The importance of a programme that is intensive enough and follows the instructions specifically is therefore noted here.

*Parents As Teachers programme* started as a pilot project in 1981 aiming to test the feasibility of influencing children's education through a partnership with their parents. The programme included thorough home visits by parent educators prenatally or at birth till 5 years of age. The parent educators are mostly people with professional education with experience in the fields of education, health care or social work related to young children and families and they all receive a week of training. The home visits last for about an hour and are scheduled once a month, biweekly or weekly based on the family needs and availability of local budget. Wagner and Clayton evaluated two randomised trials of PAT and found small but inconsistent positive effects of the programme on parents knowledge, attitude, and behaviour but no benefits on development and health of the children. However, when the data were analysed by subgroups there was a significant benefit in the cognitive, communication, social, and self-help development of the children from primarily Spanish speaking families assessed by using Developmental Profile II (based on parents reports and field evaluator observations), BSID subscales and Peabody Picture Vocabulary Test. Those children who received more intensive services benefited more from the programme than those who received less intensive services (Wagner and Clayton 1999) and therefore intensity of the services may be an important factor in such programmes.

*The home instruction programme for preschool youngsters (HIPPY)* is an example of parent-focused programme in USA. It aims to maximise children's success in their first few years at school by empowering parents to act as primary educators of their children. It was developed in 1969 and by 1999 121 HIPPY programmes served more than 15000 families in USA. The programme consists of bimonthly home visits by paraprofessionals lasting for ½ an hour supplemented in alternate

weeks by group meetings of parents, paraprofessionals, and co-ordinators (Woods 1999). Several studies have evaluated the programme and despite different designs and variations in methodological rigor, have found promising results. Baker in a brief review of the programme presents the findings from a series of interconnected research studies (Baker et al. 1999). In New York 2 cohorts of children and their families were randomly assigned to either receive HIPPY in addition to a full day, high quality preschool programme or the preschool programme only. Those who received both HIPPY and preschool programme were considered as the experimental group and those who received the preschool only acted as controls. The study therefore examined the effect of the HIPPY programme over and above that of a preschool programme. The children in the 2 cohorts performed differently. In cohort I the HIPPY participants outperformed the control children on reading, cognitive skills and classroom adaptation, whereas in the cohort II none of these results could be replicated. The authors could not find any explanation for the difference of the results in the two cohorts and there was no statistical difference between the two groups. In another quasi-experimental study in Arkansas, HIPPY families were compared with families matched on key characteristics but they were not randomly selected and none of the groups attended any preschool programme during the first year. Therefore the Arkansas study assessed HIPPY programme's effects separately from preschool enrolment. Similar to the New York study, two cohorts of children were examined. The HIPPY children in cohort I showed a trend of better classroom adaptation in the first year and showed significantly better classroom adaptation in the second year. The HIPPY children were also more likely to be promoted to the first grade. In contrast to the results of the cohort I, the control children in cohort II performed better than the HIPPY group in terms of school readiness and standardised achievement at the end of preschool programme. No statistical explanation for these differences in both the studies was found in the analyses. It was concluded by the authors that considering the cohort I in both the New York and Arkansas studies, HIPPY programme had some promising result, however, its effectiveness needs to be examined further. As two cohorts benefited, another was actually worse off and another had no benefit this interpretation would appear to be over optimistic.

*Comprehensive Child Development Programme (CCDP)* is a two-generation programme that provides educational, health and social services to low income families through home visiting and case management. This was a five-year demonstration project of the US Department of Health and Human Services. The programme aimed to improve the physical, social, emotional and intellectual development of poor children from birth to five years of age. At the same time it assisted their parents and other family members to become financially self-sufficient. The programme was started in 1989-1990 and was conducted in 24 sites. Since the programme was found to be working well, a national evaluation of its impact was called for. Poor families with an unborn child or a child less than one year of age were randomly assigned to programme or control group in 21 of the original 24 sites. Another group of replacement families were also randomly selected to replace those who dropped from the programme but they were not included in the evaluation. The programme consisted mainly of home visits 2-4 times per month for approximately one hour, started in the child's first year of life and continued until the child entered school. Paraprofessionals who were extensively trained provided case management and early childhood education to parents and children. Some of the children were also enrolled in a centre-based ECCD when they reached 4 or 5 years of age. Impact evaluation of the programme was conducted in 21 project sites and included 2213 and 2197 families in the programme and control groups respectively. Though the programme had a robust randomised design and ensured high quality of intervention, it failed to produce any effect in the programme group. Some changes were shown in the lives of the families in a positive direction, but there were no significant difference in the two groups. The authors concluded:

*"If the aim is to enhance the development of children from low-income families, then it is important to provide high quality, centre-based early education services for children".*

St. Pierre and Layzer 1999

The results of this evaluation clearly show the importance of randomisation to draw a specific conclusion in such cases.

*Healthy Families America (HFA)* was established in 1992 by the National Committee to Prevent Child Abuse (NCPCA) to provide training and technical assistance to localities developing home visiting services of their own. The programme aimed at providing support to all families at the time of their child's birth but offered home visitation services to those families with higher risk of parenting and child abuse. The home visits began once a week during pregnancy or after child was born but the frequency was decreased as families met their special needs and continued till the child became 5 years old when necessary. Contrary to most programmes that used paraprofessionals, the home visitors in this programme were mostly graduates and had prior experiences in the field of home visitation programmes. It served about 18000 families by 1997 in 38 states and the District of Columbia (Daro and Harding 1999). The programme has been evaluated by many researchers in different states of the country, however most evaluations employed single-group pretest-posttest design. A few used comparison groups and fewer had strong randomised designs. A few randomised studies that looked at the impact of the programme on child development did not show any significant differences between the programme and control groups (Daro and Harding 1999) however; since the programme evaluations have recently been started it is not possible to determine long-term effects of the programme. It may be more appropriate to wait for larger samples and longer observation period before dismissing the programme. Moreover, the programme brought about some positive changes in maternal quality of life, which in the long run may influence children's cognitive functioning.

*Vermont intervention programme for low birth weight infants* was conducted by Achenbach and his colleagues using a home visiting intervention for LBW children in Vermont. Infants born at less than 37 weeks of gestation with a birth weight below 2250 g were assigned to either experimental or control group by the toss of a coin and those born with birth weights over 2800 g and gestational age over 37 weeks, after each control child were included as a comparison group. The intervention was based on Mother-Infant Transaction Programme designed to improve maternal child interaction through seven daily sessions in hospital before the baby was discharged and four home sessions at 3, 14, 30 and 90 days after

discharge. A neonatal intensive care nurse conducted the intervention. Children's cognitive function and mothers' self-confidence and satisfaction were measured at 6, 12, 24, 36 and 48 months. There was no difference in children's development between the intervention and control groups at 6 and 12 months of age, the difference approached significance levels at 24 months and became statistically significant at 3 and 4 years when the intervened children were no longer different from the NBW children. The intervened mothers had higher satisfaction with their mothering and greater self-confidence. They also reported better perception of their child's temperament (Rauh et al. 1988). These children were later followed up at 7 and 9 years of age by the same research group (Achenbach et al. 1990; Achenbach et al. 1993). It was found that intervention had significant effects on children's mental development, school achievement and behaviour. The intervened children were no longer significantly different from the NBW children and had caught up with them at both 7 and 9 years of age, while the control children were significantly behind the other two groups and further declined in their scores (Fig. 1.3.2.). Providing care by a qualified staff may ensure the quality of the intervention but at the same time makes it difficult for large-scale implementation in less developed countries with limited resources.

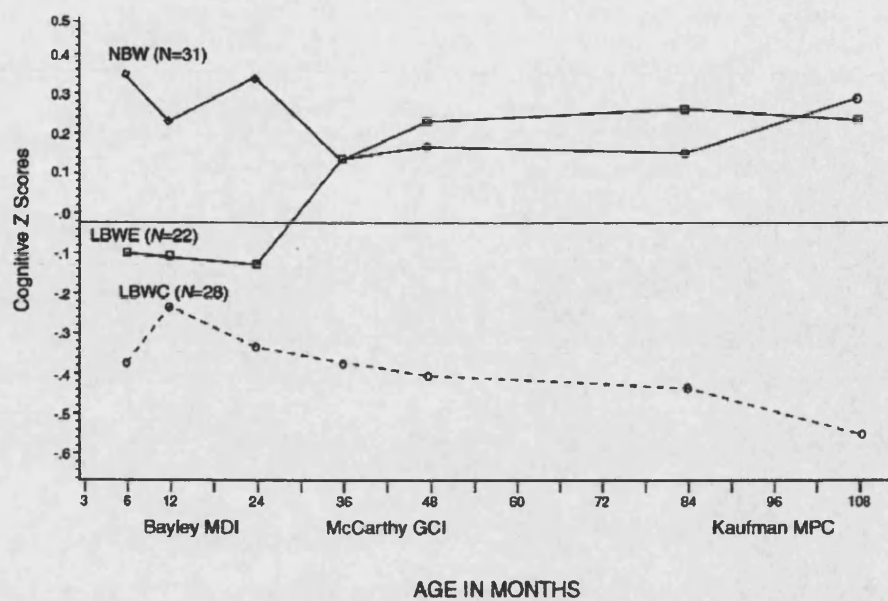


Figure 1.3.2. Cognitive scores converted to z scores at each testing for children who were tested at 6 months and 108 months and who missed no more than one test from age 6 to 108 months. NBW, normal birth weight; LBWE, low birth weight experimental; LBWC, low birth weight control; MDI, Mental Development Index; GCI, General Cognitive Index; MPC, Mental Processing Composite.

Achenbach et al. 1993

**Table 1.3.2. Home visiting programmes in USA**

Study, Author, Year, country	Sample/Design	Providers	Result
Nurse Home Visitation Programme, Olds, 1999, New York	400 First time pregnant poor women and their children, randomised to 4 groups: 1. <b>Control 1:</b> Sensory and developmental screening for children at 12 and 24 months. 2. <b>Control 2:</b> Free transportation for prenatal and well-child care through 24 months + screening. 3. <b>Intervention 1:</b> Home visits by nurse during pregnancy + screening and free transportation. 4. <b>Intervention 2:</b> Home visits by nurse during pregnancy and until child's second birthday + screening and free transportation.	Nurses	At 4 years of age: No overall effect. Better cognitive development of children of smokers in the intervention group. At 15 years of age: No effect on the whole sample. Children of low-income unmarried mothers of the intervention group had fewer arrests, fewer sex partners, smoked and drank less, and had less criminal activities.
Nurse Home Visitation Programme, Olds, 1999, Tennessee	1139 First time pregnant poor women and their children, randomised to 4 groups: 1. <b>Control 1:</b> Free transportation for prenatal care. 2. <b>Control 2:</b> Developmental screening and referral services for children at 6, 12, and 24 months + free transportation for prenatal care. 3. <b>Intervention 1:</b> Home visits during pregnancy and 2 visits after the child's birth + screening and transportation. 4. <b>Intervention 2:</b> Home visits during pregnancy until child's second birthday + screening and transportation.	Nurses	At 2 years of age: No difference in cognitive development or behavioural problems.
Hawaii's Healthy Start Programme, Duggan, 1999, Hawaii	Families at risk of poor child outcomes randomised to 2 groups: <b>Intervention</b> (home visits from birth to 2 years, n=373) and <b>Control</b> (n=270)	Paraprofessionals	No difference in mental and motor development at 1 and 2 years of age.



**Table 1.3.2. (Contd.) Home visiting programmes in USA**

Study, Author, Year, country	Sample/Design	Providers	Result
Parents As Teachers Programme, Wagner and Clayton, 1999, USA	Families randomised to: <b>Intervention</b> (Home visits prenatally or since birth for 5 years, n=298) <b>Control</b> (n=199)	Professionals	No benefits on development and health of the children. Small but inconsistent positive effects on parents knowledge, attitude, and behaviour. Significant benefit in the cognitive, communication, social, and self-help development of children of the Spanish speaking families. Children receiving more intensive services benefited more.
HIPPY, Baker, 1999, New York	Families in two cohorts randomised to: <b>Intervention</b> (HIPPY + preschool, Cohort I n=37, Cohort II n=47) <b>Control</b> (Preschool only Cohort I n=32, Cohort II n=66)	Paraprofessionals	Cohort I: the HIPPY participants outperformed the control children on reading, cognitive skills and classroom adaptation. Cohort II: no effect.
HIPPY, Baker, 1999, Arkansas	No random selection, families in two cohorts matched on key characteristics only <b>Intervention</b> (HIPPY Cohort I n=58, Cohort II n=63) <b>Control</b> (no preschool Cohort I n=55, Cohort II n=50)	Paraprofessionals	Cohort I: the HIPPY participants showed a trend of better classroom adaptation in the first year, which became significant in the second year. Cohort II: the control children performed better than the HIPPY group in terms of school readiness and standardised achievement at the end of the programme.

**Table 1.3.2. (Contd.) Home visiting programmes in USA**

Study, Author, Year, country	Sample/Design	Providers	Result
Comprehensive Child Development Programme, St. Pierre, 1999, USA	Disadvantaged families in 21 project sites randomised to: <b>Intervention</b> (home visits 2-4 times per month, n=2213) <b>Control</b> (n=2197)	Paraprofessionals	No effect.
Healthy Families America, Daro, 1999, USA	Families with higher risk of parenting and child abuse randomised to: <b>Intervention:</b> (home visits once a week during pregnancy and after birth of the child, the frequency decreased later, but continued till child became 5 years old when necessary, n=117). <b>Control:</b> (no home visits n=76).	Graduates with prior experience in home visiting programmes	No significant difference between the programme and control groups. Some positive changes in maternal quality of life in the intervention group.
Intervention programme for LBW children, Rauh 1988, Achenbach, 1990, 1993, Vermont	LBW infants randomised to: <b>Intervention</b> (7 daily sessions in hospital before discharge and four home sessions at 3, 14, 30 and 90 days, n=24) <b>Control</b> (n=31) <b>Comparison</b> (NBW, n=36)	Neonatal intensive care nurse	At 6 and 12 months: no difference between the intervention and control groups. At 24 months: the difference approached significance levels. At 3 and 4 years: significant difference in development. At 7 and 9 years: significant effects on children's mental development, school achievement and behaviour. The intervened children were no longer significantly different from the NBW children.

*c) Joint-focused programmes (Table 1.3.3.)*

In a review of the effects of early childhood programmes on social outcome and delinquency, Yoshikawa concluded that the programmes that used a combination of family support and early education programmes and had sufficient intensity made largest contribution to improve children's cognitive ability and parents' child rearing practices (Yoshikawa 1995).

A well known example of a joint-focused programme is *High/Scope Perry preschool project* that began in 1962 including 123 urban black children from low-income families in Ypsilanti, Michigan with IQs between 70 and 85 (Schweinhart and Weikart 1983). They were randomly assigned to experiment or control group with slight deviation from random assignment techniques at the end as some children who were not able to attend the preschool or participate with their mothers in the home visits were transferred from the experiment to control group. Children participated in the programme for 2 years at ages 3 and 4. Intervention was conducted for 7 ½ months each year, classes were conducted for 2 ½ hours each morning for 5 days a week and teachers also made a home visit to each mother and child for 1 ½ hours weekly. The intervention children were compared annually until 10 years of age, then at ages 14/15, 19, and 27 years with a group that received no intervention in the programme. The intervened group had significantly more graduation from high school, more employment and higher salaries, less remedial education, less trouble with the law, less teenage pregnancies and more were supporting themselves (Fig. 1.3.3.) (Weikart 1998). Unfortunately, it is not possible to separate the effects of home visiting from those of activities at the centre. The results were quite exciting when the intervened group was compared with the control group however compared to middle class families who had no special preschool experience; their deficits were still large. This suggests that although these programmes benefit children in impoverished families, they do not compensate for the richness of environments found in middle class homes that have educated parents, numerous play materials and other economic advantages.

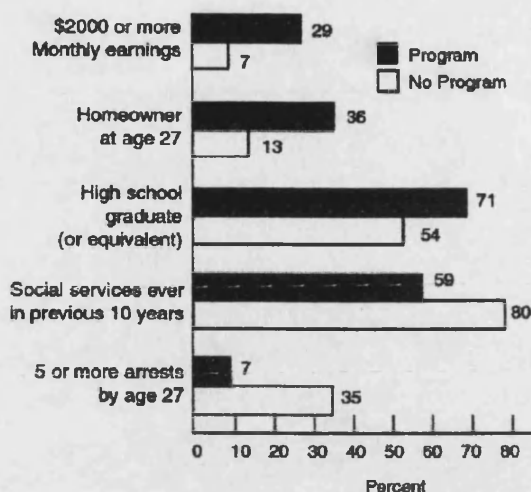


Figure 1.3.3. The longitudinal follow-up of the Perry Preschool study at age 27

Schweinhart et al. 1993

*Project CARE* was a component of Abecedarian programme. The families identified to have children at high risk of developmental delay were randomly assigned to either a control (C) or one of the two intervention groups; centre based educational day care plus family education (CDC+ FE) and family education only (FE). Intervention started one month after the child's birth and lasted throughout child's preschool years. Intervention at the child development centres was designed to improve both cognitive and social development and focused specially on language stimulation and was provided by educated individuals with at least high school graduation to master degrees with an average 7 years of experience in childcare at the beginning of the project. It followed a systematic developmental curriculum and the children could attend the day care centres from morning till afternoon. The family education programme included weekly home visits by similarly educated individuals and aimed to help parents develop their children's cognitive and social abilities using the same curriculum that was used at the day care centres. The control families did not receive any systematic programme of child development and were only supplied with iron-fortified milk for the first 15 months of their infants' life and diapers on monthly basis. Milk and diapers were also supplied to the families in the FE group. Thirteen children in the CDC+ FE were compared with 19 in the FE group and 22 in the C group for their

developmental and cognitive abilities at 6 months intervals till 54 months of age. The children in the CDC+ FE group scored significantly greater than those in the other two groups (Figs. 1.3.4. & 1.3.5.). No effect of intervention was observed in the FE group (Wasik et al. 1990).

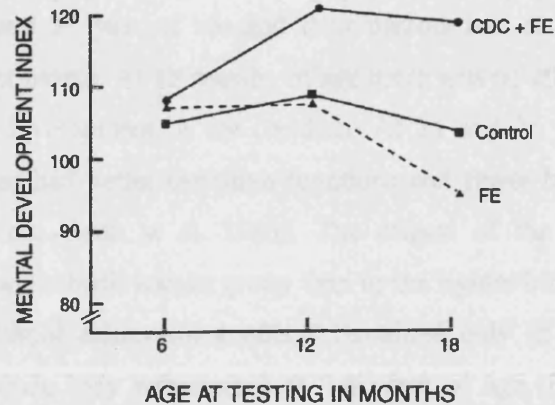


Figure 1.3.4. The mean Bayley Mental Development Index for 6, 12, and 18 month assessment occasions for the Child Development Centre plus Family Education (CDC+FE), Family Education (FE), and Control (C) groups.

Wasik, 1990

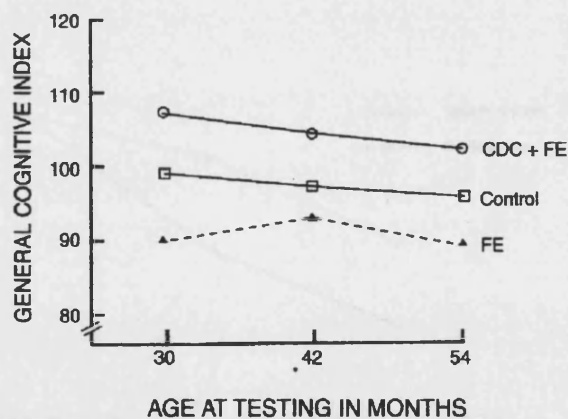


Figure 1.3.5. The mean McCarthy Cognitive Index for 30, 42, and 54 month assessment occasions for the Child Development Centre plus Family Education (CDC+FE), Family Education (FE), and Control (C) groups.

Wasik, 1990

*The Infant Health and Development Programme (IHDP)* focused on low-birth weight children. Nine hundred and eighty five low-birth weight premature infants were randomly assigned to an intervention or follow up only group. The intervention group received weekly home visits for the first year of life followed by biweekly visits for the second and third years. They also attended an educational child health programme at a child development centre 20 hours per week in the 2<sup>nd</sup> and 3<sup>rd</sup> year of life and their parents met at child development centres every other month. At 12 months of age there was no effect of intervention on the cognitive development of the children. At 24 and 36 months of age the intervened children had better cognitive functions and fewer behaviour problems (Fig. 1.3.6.) (Brooks-Gunn et al. 1993). The effects of the intervention were stronger in the heavier birth weight group than in the lighter birth weight children. Higher IQ and school achievement effects remained only in heavier low-birth-weight children when they were tested at 5-8 years of age (Berlin et al. 1998). Children who attended more often at the child centres, were visited more at home and whose parents attended more group meetings had higher IQ and a dose response relationship was suggested by the authors (Blair et al. 1995). Unfortunately as above, it is again not possible to separate the effects of home visiting from those of center based activities.

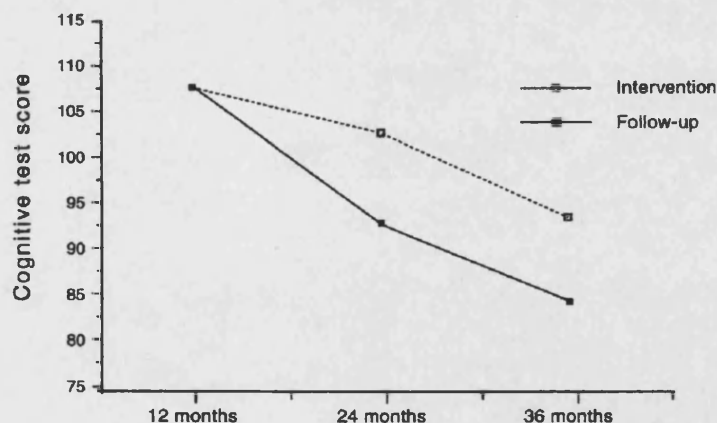


Figure 1.3.6. Children's cognitive development over time (12, 24, and 36 months) by treatment group.

Brooks-Gunn 1993

**Table 1.3.3. Joint programmes in USA**

Study, Author, Year, country	Sample/Design	Providers	Result
High/Scope Perry preschool project, Schweinhart, 1983, Weikart, 1998, Ypsilanti, Michigan	Urban black children (n=123) from low- income families with IQs between 70 and 85 at ages 3 & 4, randomised to: <b>Intervention</b> (preschool 5 days a week + home visit 1 ½ hours weekly for 2 years) and <b>Control</b>	Professionals	More of the intervention group graduated from high school, had more employment and higher salaries, less remedial education, less trouble with the law, less teenage pregnancies and more were supporting themselves.
Project CARE, Wasik, 1990, USA	High risk families randomised to: <b>Intervention 1</b> (child development centre from 6 weeks to 5 years of age and family education consisting of weekly home visits for 5 years, CDC+FE, n=13) <b>Intervention 2</b> (family education only, FE, n=19) <b>Control</b> (n=22)	Professionals	CDC+FE group had higher scores than FE and control group after 6 months of age.
The Infant Health and Development Programme (IHDP), Brooks-Gunn, 1993, Berlin, 1998, Blair, 1995, USA	985 LBW premature infants randomised to: Intervention (weekly home visits for the 1 <sup>st</sup> year, biweekly visits for the 2 <sup>nd</sup> & 3 <sup>rd</sup> years, 20 hours/week meetings at child development centres, parents group every other month, n=377) Control (n=608)	Professionals	At 12 months: no effect. At 24 and 36 months: intervened children had better cognitive functions and fewer behaviour problems. The effects of the intervention were stronger in the heavier birth weight group. At 5-8 years: Higher IQ and school achievement effects only in heavier low-birth- weight children. Dose response relationship

### *Summary*

The results of the 7 home visiting programmes on their own were disappointing and no consistent benefits were observed when the families received home visits (Gomby 1999). The intervention study with LBW babies in Vermont was remarkable in producing long-term benefits after a low intensity intervention (Achenbach et al. 1993). However, the groups were small and the results need replication.

Five studies had attrition rates of over 20% and some had methodological flaws, like using matched controls instead of random selection for the intervention. Importance of having a randomised design in establishing cause and effect has been shown in several projects. For instance, using a pre and post design without a randomised controlled trial for the evaluations of the CCDP programme generated a variety of positive effects on child and parent well-being but when a randomised design was adopted to evaluate its services, no effect was found on the outcome measures. The HIPPY programme selected the families based on volunteering to participate in a lottery and then randomised them into intervention and control groups. The results from the HIPPY programme were inconsistent across cohorts.

In some of the randomised studies after finding no benefits in the overall groups; the analyses were restricted to certain groups in the sample such as unmarried low-income women, women who smoked, or Spanish-speaking families, etc. which showed benefits of intervention. This type of analysis may eliminate the effect of randomisation, as the children in the sub-groups may be different in unmeasured factors. However, the findings suggest that high-risk children are more likely to benefit. Using professional or paraprofessional home visitors did not appear to affect results. Four of the studies used professionals (Wagner and Clayton 1999; Achenbach et al. 1993; Olds et al. 1999; Brooks-Gunn et al. 1993) to provide intervention and only one showed a benefit (Achenbach et al. 1993). Of three others that used paraprofessionals (St. Pierre and Layzer 1999; Baker et al. 1999; Duggan et al. 1999) HIPPY programme showed benefits in cohort I of both the studies, but no benefit in cohort II of the New York study and worse effects in cohort II of the Arkansas study (Baker et al 1999). The other two studies did not



show any benefit from the programme on children's development (St. Pierre and Layzer 1999; Duggan et al. 1999).

It may not however, be wise to dismiss home visiting programmes as a whole and future studies with stronger designs and ones aimed at very high risk children may have more success. Moreover, effective intervention methods are yet to be confirmed and a better understanding of effective parenting behaviours that contributes to children's cognitive development may result in better-designed intervention programmes.

All the three joint focused programmes discussed here had benefits. All were randomised and all used professionals. High/Scope had an attrition rate of over 20% but the loss in the other two studies was minimal. These programmes have proved to be more successful than home visiting programmes alone. The High/Scope Perry preschool programme that followed up the subjects till 27 years of age, was one of the most successful programmes. The joint intervention of preschool and home visits delivered with a high quality led to better academic achievement, more social responsibility, and more self-sufficient adults (Weikart 1998). However, the programme enrolled children with low IQ only and cannot be generalized to other populations. Moreover, though they were randomly selected, some breach of randomisation occurred because some children who were not able to attend the preschool or participate with their mothers in the home visits were transferred from the experiment to control group and this could have affected the results.

Project CARE had a randomised design but the sample was very small and although positive effects were shown in the CDC+FE group, the FE alone showed no benefit over the C group (Wasik et al. 1990). These findings suggest that all the benefits were due to centre-based activities however there was no group that had only centre activities. Therefore we cannot be certain whether home visiting produced additional benefits when it was combined with centre activities. However, it remains possible that the home visiting programme was not intensive enough or that it has no benefit in this population.

IHDP had a strong design and was able to show a positive effect on children's development but the programme was limited to LBW and therefore cannot be generalized to other populations. The programme showed better and sustained results in the heavier LBW children (Berlin, et al. 1998). The intervention programme failed to produce sustained improvement in smaller children and future research should aim at finding ways of improving mental development of lighter birth weight children.

In order to fully assess the effect of adding home visiting to centre-based activities a two by two factorial design would be needed with 4 groups (e.g. home visits, centre based, both combined and control). None of the three studies had this design.

### **1.3.2. Programmes in other developed countries**

A review of studies in other developed countries by Boocock is discussed here (Boocock 1995). Boocock selected early childhood programmes that had findings with policy significance and were conducted during the past two decades. In general it was found that preschool programmes in most of these countries had positive effects on school achievement of children. Many of the studies were large-scale surveys comparing attendees at preschool with non-attendees; others were observational ones comparing children who attended different types of preschool or day care programmes.

#### *Population surveys*

In UK 9000 children born during 1 week in 1970 were examined at 5 and 10 years of age for their cognitive development, educational achievement, and behaviour ratings as part of a longitudinal study. Comparison of children who attended play groups, private or public nursery schools or no preschool at all showed that attending any preschool programme was associated with improved cognitive development and school achievement of the children. The advantage from attendance at preschool was slightly greater in children who came from disadvantaged environments than in those from more advantaged families. However attendance in preschool did not influence the socio-emotional development of children. As this was an observational study we cannot be certain

that some other characteristics of the families that used preschool facilities were responsible for the children's advantage (Boocock 1995).

In France, the Ministry of Education conducted survey studies to assess the effect of attending preschool on school achievement by examining academic achievement of 20,000 children who were in the 6<sup>th</sup> grade in 1980 and comparing those who attended preschool with those who did not. The result showed that the likelihood of school failure was reduced by every year of preschool experience, especially for children coming from more disadvantaged populations. However, children from higher socio-economic status and urban areas had the most preschool experience. At present nearly 100% of 3-5 year-old children and most of the 2 year-old children attend preschool in France, therefore, it is likely that the gap between children from high and low socio-economic backgrounds will be narrowed (Boocock 1995).

In Germany data was collected from 203 elementary schools and it was noted that in districts where there was a higher number of preschool programmes fewer children were retained in grades or required special education and that attendance in a preschool was associated with readiness for school and educational success (Boocock 1995).

In an Australian study 8471 mothers having children in the first year of primary school were interviewed concerning their children's social and emotional problems that were thought to be symptomatic of a lack of school readiness. It was found that attending non-maternal childcare did not put the children at greater risk of developing socio-emotional problems. However, family background and mothers' satisfaction of their lives were shown to be more important for children's socio-emotional development and school readiness than were children's attendance in non-maternal childcare (Boocock 1995).

#### *Matched controls*

In Ireland 90 children living in impoverished areas received a two-year, half-day preschool programme as well as home visits by teachers and social workers and were compared with 60 children from the same neighbourhood who did not attend any programme. At 5 years of age the children who participated in the programme

showed significant improvements but the gains were not maintained at 8 years of age. By secondary school, the participants in the programme were more likely to remain in the school and take examinations for further education than the control group. There were however, no differences in employment or crime-commitment (Boocock 1995).

A comparative study in Canada examined 105 children who attended either childcare centres, care in the homes of regulated family childcare providers, or care by unregulated home caregivers. They found a tendency of higher language, play and activity development in the children who attended childcare centres than the children in family childcare. In addition children who attended high quality home care had better language development than those in less adequate home care. The government-regulated homecare had better quality than the unregulated homecare. It was also noted that the quality of care had more influence on the development of children from lower-class families than those in the middle-class families (Boocock 1995).

#### *Comparison of different types of programmes*

In Japan a retrospective study of 4000 children attending fifth grades showed that attending a private part-day preschool or a government subsidised full-day childcare programme resulted in higher test scores when compared to those who attended no preschool. However, between the 2 programmes, preschool children had highest scores whereas children from lower class benefited more if they attended the full-day childcare programme and were not helped by attending the preschool (Boocock 1995).

In Singapore 2413 children at 3-6 years of age were randomly selected from different preschool programmes to compare the outcomes of different types of preschools. Preschool experience prepared the children to handle academic tasks in elementary school and improved their sharing and cooperating skills. Children who attended private preschools performed better on English language tasks than those who attended government's preschools. The selection for assessment was randomised, however, there was no control group and all the children attended some preschool programmes (Boocock 1995).

In South Korea 121 children attending 4 urban kindergartens with different educational approaches were compared with 31 children who had not attended any kindergarten. The 4 curricular approaches showed differences in children's preparation for school but those differences had faded by the fourth grade and were totally absent by seventh grade. However the children participating in any of the programmes had significantly better scores in all the measures except in their IQ than the controls. The weakness of the study was that the children were not randomly assigned to the groups but they were followed up for 8 years and had a low attrition rate (Boocock 1995).

In Australia a non-randomised study examined 225 children of low-income families attending a year of preschool services through one of five models; four models of centre-based and one home-based approach and compared them with 101 control children who did not receive any preschool. The children with any type of preschool experience performed better than the controls at the time of entry to the kindergarten but by the end of the first grade the difference had disappeared (Boocock 1995).

Also in New Zealand, a review of the studies associated with children's attendance to early childhood programmes found benefits to parents like enhanced relationship with children, alleviation of maternal stress, upgrading of education, and improved employment status (Boocock 1995).

Studies in the East Asian and Pacific countries confirmed the results of the European researchers. They also noted that the benefit did not depend on the particular character of the preschool programme rather it depended on attending the preschool services (Boocock 1995).

#### *Age of entry*

In Sweden 128 children who attended centres or family childcare homes were followed up from age 3 to 13 years. Those who participated in non-parental childcare at ages earlier than one year had greater verbal facility and were more persistent and independent adolescents (Boocock 1995).

### *Summary*

The four surveys in the UK, France, Germany and Japan compared school aged children who attended preschool with controls. All showed that attendees progressed better in school. Similarly the smaller Irish and Canadian studies showed children who attended preschool had better school progress than those who did not attend and a large Australian survey found that attending non-maternal childcare even in the first year of life had no negative effect on children's socio-emotional development and school readiness.

In Australia, Japan, Singapore and South Korea studies compared different types of programmes of childcare or preschool experiences. In Japan different types of children benefited from different programmes. Although differences were apparent in South Korea these faded later. Some differences in benefits were apparent immediately after the programmes in Singapore but in the long-term differences between programmes disappeared. Finally, in Australia there were no differences in benefits gained among the different models but all were better than non-attendees albeit only for a short time. There is therefore very little evidence that the different approaches to preschool make a great deal of difference but most programmes benefit the children at least for a short time.

None of the studies had a randomised controlled design and all compared children who either attended different types of preschools or did not attend any. This raises a selection bias for evaluation, as the children from better and more educated families are more likely to attend preschool than those from poorer and less educated families. The overall conclusion by Boocock (Boocock 1995) was that attending high quality early childhood programmes benefits the development of the children, however, the lack of rigorously conducted randomised studies remains a problem with these data. There is a suggestion from the Japanese study that poorer children needed a different approach to intervention. This suggests that different approaches may have to be taken when designing programmes for poor children in developing countries, where poverty is often extreme. Also more innovative low-cost intervention programmes may have to be designed in countries with lower resources.

### **1.3.3. Programmes in developing countries**

#### **1.3.3.1. Large-scale programmes**

A review of the programmes in developing countries by WHO (WHO 1999a) discussed the following large-scale programmes:

##### ***Indonesia (PANDAI; Child development and mother's care project):***

In a programme in Indonesia home visits were conducted aimed at improving parent-child interaction. Parents were taught how to interact with their children in ways to stimulate learning and how to monitor child development using a child development card. Evaluation of an 18-month pilot intervention with 150 children, showed significant improvement in post-test scores of mental and motor development of the intervened children relative to their pre-test scores. No report of the evaluation of the full-scale programme could be located.

##### ***Brazil (PROAPE; the preschool feeding programme):***

The programme is a centre-based model where children aged 4-6 from poor areas of the cities receive food and vitamin supplementation, supervised psychomotor activities and health. Evaluations compared participants with non-participants and showed better school performance scores, lower repetition rates and higher rates of passing grades in the first and second years in participants.

##### ***Peru (PRONOEI):***

The programme consisted of food supplementation and non-formal preschool activities using a Piagetian curriculum for 3-5 year olds. Significantly higher scores in mental, motor and social development were noted in Puno where the programme was well established and control group was comparable. No difference in other departments was observed. However, children who started the programme with very low levels of abilities and social skills improved more than the control group with similar abilities.

##### ***Columbia (Hogares Comunitarios de Bienestar; Homes of well-being):***

The programme aimed to improve psychosocial, moral and physical development of children 0-7 years in the poorest sectors using community mothers to hold

preschool classes. Significant association was observed between quality of the programme and degree of well being based on a global indicator of health, nutrition and psychosocial development. The programme did not examine a control group.

*Thailand* (IFBECD: Integrated programme for child and family development and FCP: family development programme):

This programme aimed to enhance public health and nutrition services with other aspects of child development using non-formal as well as primary education. Programme villages showed an increased proportion of average and bright children but improvement was noted in both the intervention and control groups (WHO 1999a).

*India*: (ICDS; Integrated Child Development Services):

This is the largest programme for promotion of mother and child health and nutrition in the world. Begun in 1975 with a multi-sectoral programme, it covers all the basic services for improved childcare, early stimulation and learning, health and nutrition, and hygiene. It has 27.6 million beneficiaries who are pregnant and lactating women, children and adolescent girls (Kapil 2002). In a randomly selected representative sample of children attending ICDS in East Delhi, the programme was not associated with a decrease in malnutrition in children aged 7-13 years, however children's attendance, age, sex and fathers' education were significantly associated with malnutrition (Bhasin et al. 2001). In a case control study in Tamil Nadu State the effect of preschool education component of the programme was evaluated. Children aged 3-5 years attending ICDS for the last 6 months were matched for age, sex and SES with those who never attended any child welfare programme. It was found that attendance in the programme had a positive influence on the cognitive development of children when compared to those who did not receive the intervention. The difference was highest in the 4+ age group, lowest in the 5+ and intermediate for the 3+ age groups (Pandey 1991). The study did not have a randomised design, and there may be other confounders that contributed to better development of children attending ICDS programme.



### *Summary of large-scale Programmes in developing countries*

Very few robust evaluations have so far been conducted in developing countries and most of the reports refer to programmes that are not designed for research purpose and have not been rigorously evaluated. Fewer resources in these countries have made it difficult to conduct well-planned expensive programmes like those in developed countries. Of the six programmes discussed above two started intervention from birth to 5 (Indonesia) or 6 (Thailand) years of age, and others provided intervention to preschool children at 2 or 3 to 5 or 6 years of age. None of the programmes had a randomised controlled trial of evaluation, One did not examine a control group and only looked at the association between quality of the programme and degree of well being based on a global indicator of health, nutrition and psychosocial development (Columbia), three had pre-post assessments of a sample of the participants (Indonesia, Peru and Thailand) and four had comparison groups of non-participating children (India, Peru, Brazil, and Thailand). The control group was not always similar to the intervened group and for example the mothers of non-participating children were better educated than those of participating ones in two out of the three departments of the PRONEI programme in Peru. Evaluation of the programmes showed positive effects in some aspects of child development or parental behaviour in India, Indonesia, Peru, Brazil and Thailand. In Columbia, significant association was observed between quality of the programme and degree of well being of the children.

#### *1.3.3.2. Experimental studies in developing countries*

Apart from the above programmes there are very few studies using a rigorous design in developing countries that examined the effects of early childhood programmes on children's mental development and school achievement. Several studies targeted malnourished children and are discussed elsewhere (chapter 1.4.) Four studies came from a developing country, Jamaica, and one each came from Turkey and Israel (Table 1.3.4.). Turkey and Israel are not strictly classified as "developing countries" but are included here because these countries are listed as developing countries in the UNICEF's report (UNICEF 2004). Moreover, the study sample was poor and living in similar conditions to those found in many developing countries.

*Jamaica:* In Jamaica a home visiting intervention was conducted for mothers of 3 year olds (aged 34-40 months) from the poor suburban areas of Kingston to improve mental development of their children by helping them to interact with their child in such a way as to improve their development. Mothers and their 3 year-old children were identified in a defined area and the children were matched with a control group of children from an adjacent area with a similar standard of housing. The programme continued for 8 months with weekly home visits for an hour by a State Registered Nurse. Mothers were shown different methods of teaching their children using playing and talking with them. When the 20 intervention children were compared with the 21 control children they were found to have mean IQs 13 points higher than the control ones, even though they had similar IQs at the beginning of the study. The mothers of the intervened children had also a better understanding of playing and having toys at home than the mothers of control children (Grantham-McGregor and Desai 1975).

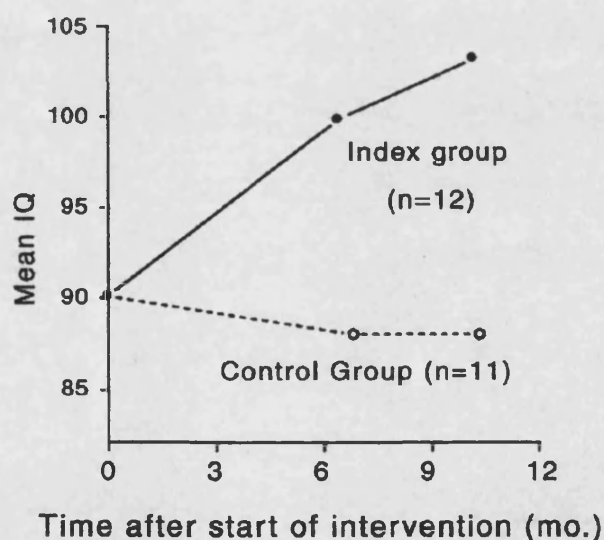


Figure 1.3.7. Mean scores in the Griffiths test of index and control children tested part-way through the study.

Grantham-McGregor and Desai 1975

In 2 other Jamaican studies frequency of home visiting and its effect on children's development was tested. In the first study 168 children aged 6-30 months from poor urban areas of Kingston were identified and selected for the study in two neighbourhoods. Children in the larger neighbourhood were divided into 2 groups of monthly and fortnightly visits; those in the eastern part were visited twice monthly and children living in the western side were visited monthly. Children in the smaller neighbourhood were not visited at home. Two years after the first study 58 children aged 16-30 months were randomly assigned to weekly visits or no intervention. Intervention included health and nutritional advice and psychosocial stimulation through home visits for one hour. It was provided by paraprofessionals who had education levels below secondary school and who received 8 weeks of health and nutrition training and another 8 weeks of training in child development, teaching techniques and toy making. A trained nurse supervised the home visitors.

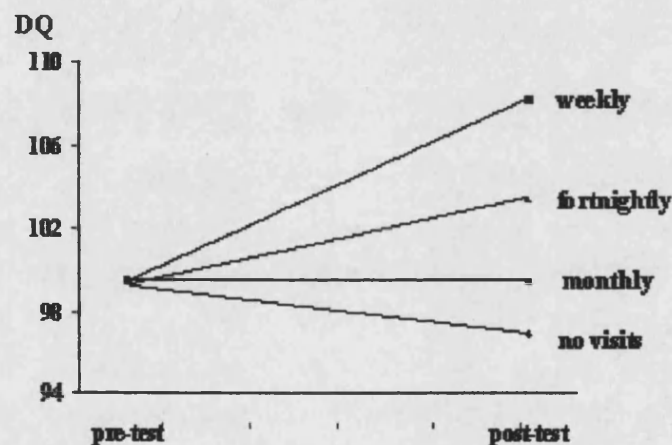


Figure 1.3.8. Effects of Different Visiting Frequency on Child DQ in Jamaica (adjusting for initial scores)

Powel & Grantham-McGregor, 1989

There was a culturally appropriate, cognitively oriented and structured curriculum that included some Piagetian concepts for children below 2 years of age and concepts of shape, size, quantity, position, motion and colour for older children. Toys were made from waste materials that were available in the homes of the children like plastic bottles, tins and material scraps. Language development was given special attention and mothers were encouraged to chat with the children

while doing their household tasks. The children's development was assessed at the beginning of the study and then after one year. The results showed that as the frequency of the visits was increased the children showed more improvement in their DQs and children who were visited weekly showed maximum improvements (Powell and Grantham-McGregor 1989).

More recently a home visiting programme of intervention was conducted among LBW-Term infants (LBW-T) in Jamaica (Gardner et al. 2003). This study selected 140 LBW-T infants who were born in the previous 48 hours in the hospital, whose mothers had attended at least two antenatal clinics, lived in Kingston or its surroundings, and had schooling below three secondary level exams. These infants were randomly assigned to intervention or control groups and were also matched for sex with another group of normal birth weight (NBW) infants. The intervention comprised of weekly one-hour sessions at home by a paraprofessional for the first 8 weeks of life. The control group was also visited at home weekly to collect morbidity data, but the visits were shorter. At 7-months of age the children were tested for their cognition using a one-step means-end problem-solving test consisting of a 'support' and a 'cover' test (Willatts 1999) and their behaviour was rated on four nine-point rating scales. The results showed that on the 'cover' test the LBW-T infants who received intervention scored significantly higher than those who did not receive intervention and did not score differently from the NBW infants. On the 'support' test the intervened children did not differ from the control children but had significant differences with the NBW children. They were also more cooperative and happy than the control infants. Although the study had no true placebo and the controls were also visited at home, the results are encouraging as it showed substantial improvement after only 8 visits using a randomised controlled design.

*Turkey:* Two consecutive studies were conducted in Turkey. A field study involved 255 three and 5 year old children who were selected from those attending educational (ED) and custodial (CUST) centres serving low-income families in Istanbul and those who did not attend any childcare services from the same neighbourhood (Home care). There was however no randomisation in selecting the

type of childcare the children received. The 3 groups were then randomly assigned to a Mother Training (MT) and a No Mother Training (NMT) group. But there was some breach of randomisation and some of the children from the MT group were reassigned to NMT as mothers couldn't participate in the programme. There were smaller numbers of children in the ED group as compared to the other two groups because limited number of children could be accommodated in the nursery schools. There were therefore 6 intervention groups in each of the 2 age groups. There were however, few children in each of the 12 groups and the age groups were combined in the 2<sup>nd</sup> study, which was a follow-up of the 1<sup>st</sup> study 7 years after the completion of intervention. The mother training programme had 2 components; a cognitive component, which was adapted from an Israeli programme, the Home Instruction Programme for Preschool Youngsters (HIPPY), and a mother enrichment component that used biweekly group meetings to strengthen mothers' parenting and communication skills. The programme used paraprofessionals to train mothers to work with their preschool aged children on educational activities. The children were examined for their development and school achievement 4 and 10 years after the initiation of the programme. The results of the 1<sup>st</sup> study i.e. fourth-year findings showed significantly higher IQs among children who received MT. The children in the ED group had significantly higher scores on IQ and tests of analytical ability than those in the CUST and home care groups. Children in the CUST group scored significantly lower in the Children's Embedded Figure Test (CEFT) than those in the other two groups. The groups receiving MT had significantly higher scores on general ability scores across the three environments, but other academic achievement tests i.e. Turkish and mathematics scores were not affected by MT or preschool environment. At 5 years there was a main effect of MT and a suggestion that the poorer types of care benefited the most but this was not a significant interaction (Kagitcibasi et al. 2001). The results of the follow-up study showed a long-term significant impact of MT on school achievement, socio-emotional development and IQ after controlling for initial IQ. In addition, the group attending educational care centres and receiving MT out performed other groups on cognitive development and school achievement even after 10 years of initiation of the study and 6 years following its completion (Kagitcibasi et al. 2001).

*Israel:* A small experimental study was reported from Israel that was based on a theory that parental behaviour affects children's development. The study was a randomised trial of training urban low SES mothers. Sixty-eight mother-infant pairs were randomly assigned to an experimental or a control group. The children were recruited between 6 and 18 months of age from families who had both parents living together and who did not have more than 3 children. Both the groups were visited at home for one-hour weekly for an average of 7 months by paraprofessionals. Mothers in the experimental group were given instructions on improving the quality of their mediation behaviour by following 5 basic mediation behaviours. These behaviours were listed by Klein and Alony as follows:

- a) *Focussing (intentional focussing of attention)*
- b) *Affecting (expression of affect and excitement)*
- c) *Expanding (explaining or associating with experiences beyond the immediate context)*
- d) *Encouraging (praising or encouraging)*
- e) *Regulating (controlling actions in form, time and space or planning and sequencing)*

The mothers in the control group were also visited at home where they were provided with information on milestones of development in early childhood and on the favourable conditions that help improve the children's development (Klein and Alony 1993). Children's development and mothers mediating behaviours were assessed at the beginning of 7 months of intervention and was repeated at the end of the 1<sup>st</sup> and 3<sup>rd</sup> year. The results showed that mothers in the experimental group had shown significant improvement in their mediation behaviour, which persisted 3 years after the intervention. Similarly their children provided significantly more mediation to their mothers and showed higher scores on Peabody Picture Vocabulary Test (PPVT), Auditory Reception and Auditory Association measures. This study was conducted in a poor urban community, which was selected by the Ministry of Education and the Office of Welfare in Israel for intervention, as most children had poor school records, high rates of failure and school dropouts. The study had a strong randomised design and used paraprofessionals who have been found to be capable of conducting such interventions elsewhere.

**Table 1.3.4. Experimental home visiting studies in the developing countries.**

Author, Year, country	Sample	Design	Providers	Intervention	Result
Grantham-McGregor, 1975, Jamaica	41 children, 34-40 months	Matched case-control study	Registered nurse	Weekly home visits for one hour, for 8 months	Intervened group gained 13 DQ points. Mothers had better understanding of play.
Powell, 1989, Jamaica	168 children, 6-30 months	Non-randomised, allocation to groups by geographical division	Paraprofessional supervised by a nurse	Fortnightly, monthly or no home visits for one year	Fortnightly visited group had higher DQs than monthly visited group who had higher DQs than those not visited.
Powell, 1989, Jamaica	58 children 16-30 months in same residential area as above	Randomised to intervention and control	Paraprofessional supervised by a nurse	Weekly or no home visits for one year	Weekly visited group had higher DQs than those not visited at home. Also higher than fortnightly visited in the above study
Klein, 1993, Israel	68 children, 6-18 months	Randomised to intervention and control	Paraprofessional	Home visits for one hour every week for 7 months	Children showed significantly more mediation behaviours to their mothers, had higher scores on Peabody Picture Vocabulary Test (PPVT), Auditory Reception and Auditory Association measures. Mothers showed significant improvement in their mediation behaviour, which persisted 3 years after intervention.

**Table 1.3.4. (Contd.) Experimental home visiting studies in the developing countries.**

Author, Year, country	Sample	Design	Providers	Intervention	Result
Kagiticbasi, 2001, Turkey	225 children 3 & 5 years of age, Three groups of children in educational day care, custodial care, or home care	Assignment to preschool not randomised. Subsequently randomised to receive mother's training (MT) or not (NMT)	Paraprofessional	Three groups each randomly divided into MT or NMT at 3 & 5 years of age	The group attending educational care centres and MT outperformed other groups on cognitive development and school achievement even after 10 years of initiation of the study and 6 years following its completion
Gardner, 2003, Jamaica	140 LBW-T infants <48 hours old, 94 matched NBW infants	Randomised to intervention and control	Paraprofessional	Weekly one-hour session at home for the first 8 weeks of life	At 7-months: on the 'cover' test: intervened LBW-T infants scored significantly higher than the controls and did not score differently from the NBW infants. On the 'support' test: the intervened children did not differ from the control children but had significant differences with the NBW children. Behaviour: intervened children were more cooperative and happy than the control infants

NBW= normal birth weight, LBW-T = low birth weight -term



### *Summary*

All the six experimental studies discussed above found benefits to the children. They all had pre and post intervention measures and used control groups. Two in Jamaica and one in Israel used random assignment to treatment, whereas two used matched controls, the other one in Turkey had a semi-randomised design as the initial selection of type of care was not randomised but the assignment to MT or NMT was randomised. There was a wide age range among the studies. One study intervened with LBW children beginning within 48 hours of birth for 8 weeks, 3 worked with children of 6-30 months of age and two were conducted among three-five year olds.

Four of the studies were conducted in a poor developing country; Jamaica, whereas the other two studies were conducted in Turkey and Israel, which are not as poor as Jamaica though listed among the developing countries.

In the first Jamaican study (Grantham-McGregor and Desai 1975) children who received home visits showed a marked benefit of almost 1 SD in developmental levels. The study used a carefully matched control group. The children's assignment to different frequencies of home visits in the second study (Powell and Grantham-McGregor 1989) was also similar and not by a random method. The lack of a randomised design weakens the ability to infer causality in these two studies because other differences between the groups may have contributed to the intervened group's better development. However, the researchers tried to control for the socio-economic backgrounds in their analyses. Two of the Jamaican studies used random assignment to treatment (Powell and Grantham-McGregor 1989; Gardner et al. 2003) and both showed benefits suggesting that the findings of the previous non-randomised studies were also valid. In addition, the finding that weekly visits produced greater benefits than 2 weekly visits and both were better than monthly visits suggests a dose response and further strengthens the inference of causality.

None of the Jamaican studies had a long term follow up. However, two further studies using the same intervention approach were conducted with malnourished children, (discussed in the chapter 1.4) and they showed sustained benefits at 12

(Walker et al. 2000) and 17 (Grantham-McGregor et al. 1994) years of age. Preliminary analysis of the most recent follow up of the former study (Walker et al. 2000) indicates that the benefits at 17 years of age are considerable and wide ranging, including improvements in school achievement, cognition and psychosocial function (Grantham-McGregor, personal communication).

The more recent Jamaican study (Gardner et al. 2003) was very low cost and used a different approach comprising only 8 weeks of home visiting in the first two months of life with LBW children. The intervened children showed benefits at 7 months of age. It may be that in these early weeks both mothers and babies are particularly sensitive to intervention. However, the benefits may not be sustainable and a follow-up of the subjects at a later age is necessary.

The Turkey programme proved beneficial effects of adding a home visiting component to other preschool interventions. Children who attended a high quality preschool centre and received home visiting had the best cognitive function and school achievement even 6 years after the programme was completed. However, the placement in preschool was by self-selection so we cannot be sure whether the characteristics of the children in educational preschool were different from those in other forms of care. The assignment to MT was randomised. Therefore the finding of benefits from MT is reasonably certain. The study also had a small sample size with 12 different groups.

The study in Israel, though not strictly a developing country, was conducted among the low SES women and children and proved beneficial effects of training mothers to optimise their children's development (Klein and Alony 1993). The study however, did not have a true placebo and the mothers and children in the control group also received home visits.

#### **1.3.4. Discussions on ECD programmes**

##### *Developed Countries*

In the USA the results of the centre-based programmes have generally shown immediate cognitive benefits but the effects decline once the children leave the

programme (Barnett 1998). Long-term effects were not observed in all the studies but some showed better school achievement, lower retention in grade and better social adjustment (Barnett 1995).

It is more difficult to conclude from the literature from the USA on the effects of home visiting on child development and future school achievement. Home visiting programmes have yielded some positive results but as a whole the programmes have not been very successful. Gomby suggested that the different results from home visiting programmes among different populations, sites and families warranted a reconsideration of the approach, although high-risk children in particular were most likely to benefit from the programmes (Gomby 2000).

The programmes that used both child-focused and parent-focused approaches have shown the best results. The High/Scope Perry Preschool programme was able to show long-term effects up to 27 years of age (Weikart 1998). It was calculated that the economic benefits of the programme in terms of improved adult education and employment, and reduced delinquency were much more than the original cost (Barnett 1993).

Though poor children generally benefited from preschool intervention they were unlikely to catch up to middle class children who do not receive the intervention but had other opportunities for development (e.g. Hertzman and Wiens 1996). The importance of socio-economic condition in such situations cannot therefore be underestimated. It is suggested that better socio-economic condition can act as an important buffer in protecting against the threats to human development.

### *Developing Countries*

The fact that most programmes were in the USA, limits their generalizability to other places particularly developing countries where the problems are greater. In addition to the poor quality of stimulation in the home and low parental educational levels, children are often exposed to poor nutrition and frequent infections.

There are few well-evaluated programmes from developing countries. The few from Jamaica suggest that home visiting may be more successful than in the USA and sizeable results in terms of IQ were noted.

A further consideration is whether this approach is feasible to conduct on a larger scale. Professionals conducted the visits weekly in the first Jamaican study (Grantham-McGregor and Desai 1975) and used bought toys and this was an expensive model for a developing country. Subsequent studies used paraprofessionals and home made toys (Powell and Grantham-McGregor 1989; Gardner et al. 2003) and this model is more likely to be affordable in a developing country. The long-term benefits are likely to justify the investment.

The Turkish study (Kagitcibasi et al. 2001) had similar findings to High/Scope Perry Preschool programme (Weikart 1998) in that a joint- focussed programme gave most benefits. It may therefore be concluded that for poor and disadvantaged children joint-focused programmes are the most appropriate and beneficial.

Some child characteristics may affect the outcomes such as differences in children's socio-economic condition and age at intervention. Although, interventions beginning from the earliest periods of life up to 4 years have shown benefits. In addition those who are more at risk of developmental delay like LBW or malnourished children, children of single parents, etc. tend to show greatest response to such programmes.

Characteristics of the programme shown to affect the outcomes include those that use joint-focus of centre and home based. Programmes with higher intensity and longer duration show greater effects. The use of well-trained paraprofessionals has also been successful. Programmes that use the nutrition/health infrastructures already available in developing countries have shown good results (WHO 1999a). Data presented in the chapter 1.4 shows that programmes that use several types of interventions like nutrition education, and food supplementation as well as psychosocial stimulation are more efficacious.

In conclusion, the data suggest that home visiting interventions with high-risk children are likely to be beneficial in developing countries but there is a deficit of data from extremely poor countries. Therefore, there is an urgent need to pilot models that combine nutrition and psychosocial stimulation using available resources in these countries with a low-cost, culturally acceptable, and age-appropriate curriculum.

## **1.4. REVIEW OF THE LITERATURE ON MALNUTRITION AND CHILD DEVELOPMENT**

For the last fifty years or more, much research has been conducted on the effect of nutritional deficiencies on child development. There is a vast amount of literature on animal experiments and the findings have generally shown some long-term detrimental effects on behaviour and brain function (Levitsky and Strupp 1995). The findings have been extrapolated to indicate a potential deleterious effects of malnutrition in humans.

PEM affects brain development especially during its growth spurt i.e. when the brain is developing most rapidly. An insult at this stage is more likely to have long-term if not permanent effects (Gorman 1995). The critical period during which effects of PEM are more pronounced starts from the second trimester prenatally till the second year of life (Dobbing et al. 1971; Dobbing and Sands 1971). Apart from the timing, duration, and severity of malnutrition, there are other environmental factors that usually co-exist with malnutrition and play a role in the development of the children. These factors have already been discussed in the ecology of malnutrition (chapter 1.1.). The malnourished children usually come from the poorer homes, overcrowded, unhygienic, less stimulating and lower parental education. These socio-economic factors can increase the risk of malnutrition and worsen the effects of PEM on development and behaviour of the children.

In the following chapter I will review studies on the effects of malnutrition on children's development focussing on ones from developing countries. I will divide the studies into

- 1.4.1. Cross-sectional
- 1.4.2. Longitudinal
- 1.4.3. Supplementation
- 1.4.4. Stimulation

### **1.4.1 Cross sectional studies**

Below is a description of cross-sectional studies looking at the relationship between nutritional status and development. I have divided the studies into two groups; those that assessed children in infancy and pre-school age and those that

assessed them at school age.

*1. Studies of infants and preschool children (Table 1.4.1)*

Seven cross-sectional studies are reported in this section.

In two studies, one in Colombia (Christiansen et al. 1977) and one in Jamaica (Powell and Grantham-McGregor 1985) significant correlations were found between stunting and child development. Length of the children in the Columbian study was significantly correlated with the psychological tests but was confounded by the social variables. In the Jamaican study, height-for-age and weight-for-age had significant effects on DQ but weight-for-height did not. In a third study in Ethiopia (Aboud and Alemu 1995), a relationship between weight-for-age and child development was found. In this study mothers' verbal responsivity to the child predicted child's verbal ability positively. In Jamaica, standard of housing, mothers' education and whether she worked out of the home were all related to the children's development. Developmental delay was also found in a study in Chile (Monckeberg et al. 1972) among slum children with mild and moderate PEM and in a Nigerian study where malnourished children from poor rural and urban communities had poorer development than reasonably nourished children with similar SES (Ashem and Janes 1978).

Two studies in Bangladesh were not cross sectional but randomised trials of the effects of zinc supplementation on development of children. However they are included here because significant associations were found between the children's nutritional status and developmental levels on the Bayley test at the post supplementation assessment controlling for a number of SES variables (Hamadani et al. 2001; Hamadani et al. 2002). In one of the studies (Hamadani et al. 2001) the children were tested at 7 and 13 months of age and their nutritional status deteriorated between the test sessions. The effect size of concurrent weight for age on development more than doubled between 7 and 13 months, suggesting that nutrition had a greater effect on development with increasing severity or duration.

**Table 1.4.1. Cross-sectional studies of the relationship between nutritional status and development in infants and preschoolers**

Author, year, country	Subjects	Type of PEM	Measurements	Developmental Results
Monckeberg, 1972, Chile	220 children, 1-5 years old, from slum areas and 90 from middle class	mild-mod PEM matched with normal nutritional status (WA & HA>80%)	IQ	Significantly lower IQ in PEM children
Christiansen, 1977, Columbia	87 Infants at 6-20 months 143 Preschoolers at 3-5years	Mild to moderate deficit in weight and length Vs adequately nourished	Psychological performance, Griffiths	Infants: significant correlation of length with psychological tests but SES was not controlled Preschoolers: significant correlation of length with visual perception, vocabulary & Griffiths but not with memory test.
Ashem, 1978, Nigeria	45 well nourished, 28 reasonably nourished (poor rural & urban) & 45 undernourished (poor rural & urban) at 2.5-6 years	Well to do urban: well nourished (WN =British 50 <sup>th</sup> centile for ht) compared with reasonably nourished (RN >-2 sd for ht & wt and Malnourished (MN <-2 sd for ht & wt)	McCarthy Scale of Children's abilities	The WN > RN > MN

**Table 1.4.1. (Contd.) Cross-sectional studies of the relationship between nutritional status and development in infants and preschoolers**

Author, year, country	Subjects	Type of PEM	Measurements	Developmental Results
Powel, 1985, Jamaica	168 children at 6-30 months	Stunted and wasted	Griffiths	Lower DQs in stunted and undernourished children but not in the wasted children. DQ declined with age, boys had higher DQs than girls. SES was controlled.
Aboud, 1995, Ethiopia	40 children at 16-42 months	Adequately nourished, mild, moderate and severe PEM	BSID-II	Wt/age significantly related to Bayley scores. SES was not controlled. Mothers' social interactions were related to children's development.
Hamadani, 2001, Bangladesh	212 infants randomised to zinc supplementation or placebo from 1-6 months of age	Mild, moderate, and severe PEM	BSID-II	Poorer mental development in the zinc supplemented group at 13 months. Bayley scores were significantly correlated to children's weight-for-age at 7 and 13 months controlling for SES and zinc.
Hamadani 2002, Bangladesh	168 pregnant mothers randomised to prenatal zinc supplementation or placebo	Mild, moderate, and severe PEM	BSID-II	Poorer mental and motor development and behaviour in the zinc supplemented group at 13 months. Bayley scores were significantly correlated to children's weight-for-age at 13 months controlling for SES and zinc.

BSID-II: Bayley Scales of Infant Development-Revised version



## ***2. Studies in school-age children (Table 1.4.2.)***

I identified 6 studies of the relationship between nutrition and cognition, school achievement, behaviour or neurosensory integration. All found significant associations with nutritional status.

In a Jamaican study (Powell and Grantham-McGregor 1980) the socio-economic status of the children's families was determined very crudely by asking if they had a radio at home and the type of toilet they used. The children in the lower achievement classes tended to have worse toilets and fewer radios than those in the higher classes. Although the children's nutritional status was associated with school achievement levels, school attendance had a relatively greater effect on school achievement. Poverty, necessity of children's labour at home or at work, and parents' level of education and their interest in school were thought to be the causes of poor attendance.

Two other Guatemalan studies (Cravioto et al. 1966; Johnston et al. 1987) found that the lower developmental level in the malnourished children was attributed to both SES and nutritional status, which emphasises the association between SES and development.

Two reports from India (Upadhyay et al. 1989) and Nigeria (Abidoye et al. 1991) found significant correlations between nutritional status and scores of intelligence tests (India) and academic performance (Nigeria) of the children. In the Indian study the stunted children had lower IQ scores than those who were wasted and on multiple regression analyses SES was also found to significantly affect IQ. In a study in Vietnam school children's height-for-age and weight-for-age were correlated with their mathematics and Vietnamese test scores (Hall et al. 2001). They however did not assess the socio-economic condition of the children.

All the studies found relationships between malnutrition and mental development. All but one (Hall et al. 2001) controlled for SES and found an association between SES and children's development.

**Table 1.4.2. Cross-sectional studies of the relationship between nutritional status and measures of cognition, behaviour and school achievement of school-aged children**

Author, year, country	Subjects	Type of PEM	Measurements	Developmental Results
Cravioto, 1966, Guatemala	Rural and urban children 6-11 years	Adequately nourished and stunted	Neuro-integrative behaviour	In rural children difference in height was associated with difference in neuro-integrative behaviour, but the difference did not exist among the urban children.
Powel & McGregor, 1980, Jamaica	449 School children of grade VII	Adequately nourished, mildly stunted and undernourished	School achievement (WRAT)	Significant association between school achievement, nutritional status and school attendance. School attendance contributed more to the variance in achievement levels than nutritional status
Johnston, 1987, Guatemala	459 urban children, 4-9 years	Adequately nourished and stunted	WISC	Lowest IQ found amongst the shortest and lowest SES quartiles. Children from the most disadvantaged group did not show any relationship between stature & IQ. SES was seen as a more important determinant of IQ than stature.
Upadhyay, 1989, India	1336 rural primary school children 6-8 years	Adequately nourished, mild, moderate and severe PEM	WISC	The mean scores for full scale (FSIQ), verbal (VIQ), & performance (PIQ) decreased progressively with the severity of PEM. The scores did not reach the degree of mental retardation.
Abidoye, 1991, Nigeria	250 children randomly selected from 53 urban primary schools aged 6-13 years	Adequately nourished, mild, moderate and severe PEM	Academic performance	PEM was associated with poor academic performance & class repetition.
Hall, 2001, Vietnam	3055 children in class 3	50 children in each group of 0.5 z score	Mathematics and Vietnamese	Negative correlation of test scores with height-for-age and weight-for-age.

WRAT: wide-Range Achievement Test, WISC: Weschler Intelligence Scale for Children

### **Discussions on cross sectional studies**

Cross sectional studies have the weakest design when exploring causal relations between development and nutritional status and may only help to give a quick insight into possible causes for further exploration (Connolly and Grantham-McGregor 1993). It is not possible to establish temporal relations between the variables to determine which variable preceded the other. It is also not possible to determine changes, as the child gets older.

In all the five studies of infants and preschoolers nutrition was associated with the development of the children.

Most of the studies (Christiansen et al. 1977; Ashem and Janes 1978; Powell and Grantham-McGregor 1985; Hamadani et al. 2001; Hamadani et al. 2002) made some attempt to control for socio-economic background; however, it is possible that other unmeasured environmental variables could account for the relationship between malnutrition and development. The studies in school aged children also showed an association of nutritional status with mental development or school achievement. However, only the study in Guatemala (Johnston et al. 1987) controlled for the SES differences among the children.

#### **1.4.2. Longitudinal studies**

Longitudinal studies give an idea of the prognosis of early childhood malnutrition but only prospective ones beginning before the episode of malnutrition can determine the development of children before they become malnourished. Unfortunately, most studies of malnourished children began after the child was malnourished because investigators are obliged to prevent the occurrence of malnutrition when studying children.

Several studies were conducted of children who were malnourished in early childhood and then followed up at a later age when their cognition and/or school achievement were examined. These studies involved children suffering from severe PEM who were either hospitalised or were in the community as well as children mildly and moderately malnourished. The review is therefore divided into studies of children with severe PEM and those of children with mild or moderate PEM.

### ***I. Studies involving children severely malnourished in early childhood***

Here the studies are divided into three groups; those that follow the children in infancy and preschool age, those looking at school-age children and those that follow them to adolescence and adult life.

#### ***1. Infants and preschoolers (Table 1.4.3.)***

I located 8 studies of children who were severely malnourished in infancy and followed-up for a few years and were then compared with matched normal children. One study had no controls but used theoretical normal mean for their age (Cravioto and Robles 1965). There were three studies; two in India (Agarwal et al. 1992; Vazir et al. 1998) and one in Ethiopia (Drewett et al. 2001) in which whole cohorts of children with varying nutritional status in a certain area were followed and their development compared within the group. Two studies in Jamaica (Grantham-McGregor et al. 1989a) and Philippines (Reyes et al. 1990) had special designs in which children suffering from different types of malnutrition were compared with each other and with normal children. Two other studies in South Africa (Stoch and Smythe 1996) and Lebanon (Botha-Anthoun et al. 1968) compared severely malnourished children with normal children. The study in Lebanon (Botha-Anthoun et al. 1968) was the only study that observed the children before they became malnourished.

In an early study in Mexico, Cravioto and Robles examined children suffering from severe PEM and compared them to a theoretical normal developmental age. They all had subnormal DQ scores on admission to hospital but only those admitted before 6 months of age did not improve in their development with nutritional rehabilitation (Cravioto and Robles 1965). In Lebanese (Botha-Anthoun et al. 1968), Indian (Agarwal et al. 1992), South African (Stoch and Smythe 1996) and Filipino (Reyes et al. 1990) studies the development of the malnourished children was significantly poorer than that of the controls who had similar SES.

Investigators in Jamaica noticed that in severely nourished children, height-for-age was more closely associated with developmental levels than weight-for-height or oedema. They, therefore, compared the development of children who had been

admitted to hospital for severe PEM (defined by the Welcome classification; please see chapter 1.1.) and had left hospital within the previous one to 6 months with children who were matched for age and the degree of stunting but did not have a severe episode of malnutrition. A third group of non-stunted children were also matched for age with the above children. All children came from similar socio-economic backgrounds. The developmental quotients (DQ) were significantly higher in the age-matched non-stunted children, than the other two groups. However there was no difference in DQ between the severely malnourished children and the groups matched for height. The authors suggested that developmental delay in the severely malnourished children was mainly explained by factors associated with stunting rather than wasting or oedema indicating the effects of longer duration of malnutrition on children's development (Grantham-McGregor et al. 1989a).

A study in Ethiopia (Drewett et al. 2001) clearly showed a significant delay in development of children attributable to malnutrition. In the Indian study (Vazir et al. 1998) with a large sample the malnourished children were significantly delayed in their development. The children's psychosocial development was however, more dependent on fathers' involvement with child-care and this could be related to better psychosocial stimulation at home.

All the 8 studies found significant associations of early malnutrition in infancy and development in later childhood. Except for the Mexican study that had no controls (Cravioto and Robles 1965) all others either controlled for the SES differences or had carefully matched controls.

**Table 1.4.3. Follow up studies of the association between severe PEM in early childhood and cognitive function in later childhood (7years and under)**

Author, year, country	Subjects	Measurements	Developmental Results
Cravioto, 1965, Mexico	20 children, 3-42 months having severe PEM, compared with theoretical normal mean for their age	Gesell Test	Infants < 6 months had lower developmental age in spite of rehabilitation. Others improved with age. Language was most affected and improved slower than other sub-scales.
Stoch, 1996, South Africa	21 severely malnourished children compared with 21 matched controls tested yearly till 7 years	IQ tests: Gesell and Amtruda's Infant Scale of mental Development, Binet-Simon intelligence Scale	Head circumference and IQ significantly higher in control children.
Botha-Antoun, 1968, Lebanon	22 children who were <10 <sup>th</sup> percentile in wt and ht before 18 months of age (20 of which <3 <sup>rd</sup> centile) compared with matched controls tested at 4-5 years	Stanford Binet	IQ was lower in PEM children; they were also delayed in walking & talking.
Grantham-McGregor, 1989, Jamaica	29 children with severe PEM matched for age and degree of stunting with 29 stunted children and matched for age with 15 non-stunted children, tested at 6-24 months	Griffiths	DQ: non-stunted > Severe PEM & stunted No significant difference in development of severe PEM and stunted children.

**Table 1.4.3 (Contd.) Follow up studies of the association between severe PEM in early childhood and cognitive function in later childhood (7years and under)**

Author, year, country	Subjects	Measurements	Developmental Results
Reyes, 1990, Philippines	Gr. I: n=31 Normal nourished, Gr. II: n=26 Normal but previously malnourished, Gr. III: n=30 acutely malnourished, Gr. IV: n=15 Stunted but not presently malnourished, Gr. V: n=28 Chronically malnourished, tested at 4-6years	Motor, perceptual and cognitive tests	Motor: Normal children outperformed all the PEM groups in fine motor but no difference on gross motor activities.  Cognition: No significant difference.  Total score: Gr. I & II had significantly higher scores than Gr. III, IV & V.
Agarwal, 1992, India	196 rural children tested at 18, 24, 30 & 36 months of age normal, grade I, II, and III PEM	DQ	Lower scores in PEM children. DQ decreased with severity of PEM. Maternal involvement and psychosocial stimulation were strongly associated with better behaviour development and intelligence
Vazir, 1998, India	2212 well nourished & grade I PEM compared with 1456 grade II & III PEM, tested at 0-6 years	Milestones of development	Grade II & III PEM children had delayed developmental milestones to the extent of 7-11 months
Drewett, 2001, Ethiopia	97 growth falterers <1.8sd weight-for-age in 1 <sup>st</sup> year of life, compared with 100 normal ≥1.8sd through out 1 <sup>st</sup> year tested at 2 years of age	BSID	Significant difference between growth falterers & normal children, significant correlation between Bayley & weight from 4 months onwards, highest correlation at 24 months.

## **2. *School-aged children***

I located 14 studies that followed children up to school age. Three of the studies have used siblings of the same family as comparisons to control for the effects of SES in addition to using matched controls, while other eleven used unrelated matched controls only. These studies are reported based on the inclusion of siblings or not.

### **i) Matched controls only (Table 1.4.4.)**

Eleven studies that used matched controls are discussed here. An Indian study (Champakam et al. 1968) showed that although the children had improved in their nutritional status they still had a developmental deficit compared with well-matched control group, but the deficit diminished with age. In two studies in Uganda (Hoorweg and Stanfield 1976) and Indonesia (Pek et al. 1967) the development of formerly malnourished children was significantly poorer than that of adequately nourished children matched for socio-economic background. In the Indonesian study when they were grouped on the basis of SES and height, the poorer and shorter children had lowest IQs. In all the reports by Galler and colleagues (Galler et al. 1984a; Galler et al. 1984b; Galler et al. 1985a; Galler et al. 1987a; Galler et al. 1987b; Galler et al. 1987c), the previously malnourished children in Barbados performed poorer than the adequately nourished children even after controlling for environmental differences. In another Indian study soft neurological signs persisted in the malnourished boys (Upadhyay et al. 1995) and when reaction time to audiovisual stimuli was measured the previously malnourished children showed a prolonged reaction time (Agarwal et al. 1998). Two studies, in Peru (Berkman et al. 2002) and the Philippines (Mendez and Adair 1999), comprised cohorts of children with varying nutritional status who were followed over time. There were significant associations between early childhood stunting and later cognition and school performance after controlling for SES and concurrent nutritional status.



**Table 1.4.4. Longitudinal studies of children who had severe PEM in early childhood and were compared at school age with matched controls**

Author, year, country	Subjects	Measurements	Developmental Results
Pek, 1967, Indonesia	31 severely malnourished in infancy and 33 healthy rural children, with low SES, tested at 5-12 years	WISC	Malnourished group had significantly lower IQ than controls. Poorer and shorter children had lower IQ.
Champakam, 1968, India	19 children admitted for kwashiorkor at 18-36 months, matched with 50 controls, tested at 8-11 years	Psychological tests	Significantly better performance by the controls but the difference diminished with age.
Hoorweg, 1976, Uganda	60 children admitted for malnutrition at different ages and 20 controls, tested at 11-17 years	Psychological tests	Head circumference and IQ significantly lower in PEM children. No difference in development according to age of PEM.
Galler, 1984a, 1984b Barbados	129 children suffering from marasmus in 1 <sup>st</sup> year matched with 129 adequately nourished children, tested at 4-11 years	Classroom behaviour, IQ (WISC), school grades, motor performance, soft neurological signs	PEM children had lower motor skills, academic scores, IQ, and deficit in classroom behaviour. Soft neurological signs: malnourished children performed significantly slower on several timed motor tasks when using non-dominant hand only.

WISC: Weschler Intelligence Scale for Children

**Table 1.4.4. (Contd.) Longitudinal studies of children who had severe PEM in early childhood and were compared at school age with matched controls**

Author, year, country	Subjects	Measurements	Developmental Results
Galler, 1985a, Barbados	109 children who suffered from mod/severe PEM in 1 <sup>st</sup> year of life, compared with 107 matched controls, tested at 8-15 years,	Fine motor skills (Purdue peg board)	Significantly lower scores for the PEM children. Once IQ was controlled, significant difference between groups no longer existed.
Galler, 1987a, 1987b, Barbados	108 children who suffered kwashiorkor or marasmus in 1 <sup>st</sup> year compared with 58 adequately nourished children tested at 11-18 years	IQ (WISC-R), Piagetian Test of Conservation, Fine motor skills	Lower scores in IQ, conservation and fine motor skills in malnourished children. Deficit in fine motor skills was more extensive in children with history of kwashiorkor than marasmus. Environment & Home: malnourished children were less advantaged than adequately nourished children. Significant correlation found between IQ & environmental factors. Significant independent effect of nutritional factors with IQ when environment was controlled
Galler, 1987c, Barbados	86 children who suffered from mod/severe PEM in 1 <sup>st</sup> year of life, compared with 100 matched controls, tested at 8-15 years	Piagetian Test of Conservation	No significant difference in continuous quantity & pendulums. Significant difference in solids, weight, length, area, proportional reasoning. Environmental factors were highly correlated to conservation tasks. When all 9 tasks were combined there was significant difference between the groups, the difference was still present when IQ & environment were controlled.

WISC-R: Weschler Intelligence Scale for Children-revised

**Table 1.4.4. (Contd.) Longitudinal studies of children who had severe PEM in early childhood and were compared at school age with matched controls**

Author, year, country	Subjects	Measurements	Developmental Results
Upadhyay, 1995, India	30 boys with normal nutritional status during the 1 <sup>st</sup> 5 years of life compared with 30 boys with grade II & III malnutrition during the 1 <sup>st</sup> 5 years of life-, tested at 9-12.5 years	Soft Neurological Signs	Soft neurological deficits persisted in PEM children. Significantly higher percentage of overflow and dysrhythmia. SES was not controlled.
Agarwal, 1998, India	54 children malnourished in 1 <sup>st</sup> 5 years of life (Height-for-age <90% of 50 <sup>th</sup> centile affluent Indian children) matched with 31 who maintained normal nutrition during 1 <sup>st</sup> 5 years of life, tested at 11-14 years	Reaction time to audio-visual stimuli	Prolonged reaction time in previously malnourished children even after achieving normal nutritional status at the time of testing.
Mendez, 1999, Philippines	2131 children from low-income & low-educated families persistently stunted from 0-2 years and at age 8 (n=1013), stunted at 0-2 years only (n=531), stunted after age 2 (n=80) and never stunted (n=507) tested at 8 & 11 years	Psychometric tests, school achievements in Maths & English	Children stunted at age 2 years had lower mean cognitive scores than non-stunted children with greater difference at age 8 than age 11. More schooling was associated with higher scores regardless of stunting status at age 2.
Berkman, 2002, Peru	46 children who were at least once stunted between birth to 2 years compared with 97 non-stunted, tested at 9 years	WISC-R	Stunting negatively correlated with cognitive scores after adjusting for SES and schooling.

WISC-R: Weschler Intelligence Scale for Children-revised

**ii) Matched controls and siblings (Table 1.4.5.)**

I found 3 studies that used siblings as well as matched controls. In the Jamaican study (Hertzog et al. 1972), two comparison groups were studied; siblings and non-related matched controls. Siblings scored better in tests of intelligence than the undernourished children but did not reach to the level of the adequately nourished control group. However both had poorer levels of school achievement than the adequately nourished group (Richardson and Birch 1973). The effect of SES is clearly shown in this study where children from poorer socio-economic backgrounds scored significantly lower in tests of intelligence than those in the higher socio-economic background (Richardson 1976). Moreover the index children who suffered severe PEM in early childhood but who were tall at follow up and had favourable social conditions scored higher than those without a history of PEM but who were short and had unfavourable conditions. These findings suggest that SES and subsequent growth following an acute episode of severe malnutrition modify the long-term effects. In the other two studies in Nigeria (Nwuga 1977) and India (Pereira et al. 1979), both the siblings and matched control groups scored higher than the malnourished children in tests of intelligence.

**Table 1.4.5. Longitudinal studies of children who had severe PEM in early childhood and were compared at school age with matched controls and siblings.**

Author, year, country	Subjects	Measurements	Developmental Results
Hertzog, 1972, Richardson, 1973, 1976 Jamaica	71 boys with severe PEM in 1 <sup>st</sup> 2 years treated in hospital for an average of 8 weeks, 38 siblings, 71 matched controls tested at 6-12 years	WISC, school achievement, SES	IQ scores: controls > siblings > index. School achievement: controls > siblings who were almost similar to index children. Association with height and SES: Taller boys > shorter boys, Boys with lower SES < IQ than higher SES. Boys with severe PEM but tall and with favourable social background > than boys not malnourished but short and unfavourable social background
Nwuga, 1977, Nigeria	Gr. I: 52 urban children who suffered from Kwashiorkor at 1-3 years of age, Gr. II: 34 Normal siblings. Gr. III: 32 matched lower class control, Gr. IV: 38 upper class control, Gr. V: 9 rural children who suffered from Kwashiorkor at 1-3 years of age. All tested at 9-10 years	WISC, WPPSI, Raven's progressive matrices, school performance	The lowest performance on IQ and Ravens: by the Gr. I & V. Gr. II performed significantly better than Gr. I in tests of visual memory, African picture arrangement, block design, and progressive matrices. Gr. IV showed the best performance followed by Gr. III and then Gr. II School performance of index children: 36% average, 64% below average in school work
Pereira, 1979, India	79 survivors of Kwashiorkor aged 6-12 years, 142 matched normals, 10 siblings of the survivors	Tests of intellectual ability and neurointegration, scholastic performance	Neurointegrative performance: The survivors of PEM made significantly larger # of errors than normal children. Out of 10 siblings 3 performed poorly and 7 were at the level of normal children IQ: significantly poorer performance by index children in Seguin form board at 6-10 years age-group & in Passalong test at 7 & 8 years age-group Scholastic performance: Siblings and normal children > index No improvement with age was observed in previously malnourished children

WISC: Weschler Intelligence Scale for Children, WPPSI: Weschler Preschool and Primary Scale of Intelligence

### **3. Adults and late adolescence (Table 1.4.6.)**

I only found two studies that followed children to adolescence, one of which extended its follow-up to adulthood. Stoch and colleagues (Stoch et al. 1982) followed up South African children, from a study previously described (Stoch and Smythe 1996; Stoch and Smythe 1976), when they were 15-18 and then 20 years old. The previously malnourished children showed poorer development despite having more parent-child interactions than the control children (Stoch and Smythe 1976). Significant differences were still detected in their nutritional status measurements at follow-up and the adequately nourished children had significantly better educational and occupational levels. The index boys also demonstrated lack of drive and initiative, poor maturity and social intelligence and worse social coping skills than the controls. This was one of the first studies to follow up previously malnourished children however, the groups were small and not well matched for social background.

In an Indian study (Upadhyay et al. 1995) children who had suffered grade II or III malnutrition for the first 10 years of life had more soft neurological signs than adequately nourished children at age 15 to 17.5 years.

### **II) Studies with mild and moderately malnourished children (Table 1.4.7.)**

I located two studies that followed children who had mild to moderate malnutrition in the first five years of life comparing them with adequately nourished children. In a study in Ivory Coast, children 5-21 months with mild to moderate malnutrition were tested every three months over a period of one year and were found to have poorer development than adequately nourished children (Dasen et al. 1977). In an Indian study (Agarwal et al. 1995) children malnourished during the 1<sup>st</sup> 5 years of life performed poorer than the well nourished ones in developmental tests even after controlling for the environmental effects at 10-12 years of age.

**Table 1.4.6. Longitudinal Studies of association between malnutrition and development involving children with history of severe PEM in Adolescents and adults**

Study	Subjects	Measurements	Developmental Results
Upadhyay, 1995, India	30 boys with grade II & III undernutrition for a period of 10 years matched for age and sex with 30 normal nourished boys during the 1 <sup>st</sup> 10 years of life tested at 15-17.5 years	Soft neurological Signs	More soft neurological signs with a higher percentage of overflow and dysrhythmia in PEM children  SES was not controlled.
Stoch, 1976, 1982 South Africa	20 children with PEM during infancy, 20 children with normal nutrition, matched for age & sex & same social class. Tested at 15-18 years	IQ, school achievement,	PEM children had significantly smaller head circumference, lower IQ, and school achievement and more dropouts.  Psychosocial history: Parents of normal children coped significantly better in handling the children
	Tested at 20 years	IQ, Social Integration, educational level	IQ and educational level were significantly lower in PEM children. Occupation: Index boys worked at a lower occupational level than control. Social adaptation: lack of drive & initiative, poor maturity & social intelligence, worse social coping skills in index children.

**Table 1.4.7. Longitudinal Studies of association between malnutrition and development involving children with history of mild/moderate PEM in infants and preschoolers**

Study	Subjects	Measurements	Developmental Results
Dasen, 1977, Ivory Coast	23 pairs Group I: Mod PEM at 5-21 months of age Group II: Normal nutrition Tested every 3 months over a period of one year	Sensori-motor intelligence	Whole scale was significantly lower in PEM children though they were similar in SES
Agarwal, 1995, India	Gr. I: 48 boys normally nourished during the 1 <sup>st</sup> 5 years of life, Gr. II: 32 LBW boys who remained undernourished during the 1 <sup>st</sup> 5 years of life, Gr. III: 63 boys who became malnourished between 6-12 months & remained so during the 1 <sup>st</sup> 5 years of life tested at 10-12 years of age	Weschler memory scale, abilities related to personal & current information, orientation, mental control, logical memory, digit span, visual reproduction & associative learning, card sorting test, conditional learning, fine motor coordination	Children in groups II & III when compared to Group I showed deficit in all areas of development that were tested except on finger dexterity tests. No significant difference between Gr. II and III



**Discussion of longitudinal studies:**

SES control: Of the 26 studies identified nearly all of them found differences between formerly malnourished children and children who had never been malnourished. Although longitudinal studies are helpful in assessing developmental differences between groups over time they cannot establish causation unequivocally (Connolly and Grantham-McGregor 1993). Even after careful matching for socio-economic backgrounds there may be unmeasured factors that remain different between the groups that affect development. One of the studies (Upadhyay et al. 1995) failed to control for social background, all the others made some attempt to control for SES. Many of them had extremely limited measures and factors such as stimulation in the home or maternal mental health were rarely measured. Although using siblings for comparison purposes controls for the effects of SES reasonably well, unless they are identical twins, they cannot be matched for age and the birth order of the index child. Moreover, in some developing countries such as ones in the West Indies (Hertzog et al. 1972; Richardson and Birch 1973; Richardson 1976), it is quite likely that they may not have the same biological father and therefore may experience different child-rearing conditions. Even within the same family siblings can be treated differently due to changing circumstances. More importantly siblings in the same family as the malnourished child are likely to have suffered some degree of malnutrition themselves as a result of the same environmental conditions. Therefore the differences between the children attributable to nutrition would be minimised.

In contrast to the reports from developing countries that showed a close association between malnutrition in early childhood and poor development at follow-up, findings from developed countries are less marked. For example, two studies found no significant difference between malnourished and adequately nourished children (Skuse et al. 1994; Boddy et al. 2000). It may be that the quality of stimulation in the home is better in developed countries and protective

There is also the problem of the temporal relationship between malnutrition and poor development. It is possible that children with poor levels of development are more likely to become malnourished. Only the Lebanese study assessed children before they became malnourished (Botha-Antoun et al. 1968) and found that children who became malnourished had normal levels of development prior to the

episode of malnutrition.

Though the studies were done in many different countries by different researchers they generally had consistent results. Some of them took into account reasonably extensive social background measures (e.g. Pek et al. 1967; Stoch and Smythe 1976; Stoch et al. 1982; Hoorweg and Stanfield 1976; Dasen et al. 1977). Furthermore animal studies of the effect of malnutrition on brain function as well as the "functional isolation" hypothesis provide plausible biological mechanisms. Findings of studies on animal behaviour concur with those from human studies. The strength of the associations was also considerable, and a dose-response relationship was shown in some studies e.g. the more severe the malnutrition the poorer the development (Agarwal et al. 1992; Mendez and Adair 1999) and earlier the development of stunting poorer the cognitive functions in later childhood (Mendez and Adair 1999). Therefore based on the epidemiological principles (Hill 1965) it is reasonable to infer a causal relationship however there must always remain some doubt. There is a need for clinical trials of supplementation where malnutrition is prevented or treated in one group and not in another to establish a causal relationship with greater certainty.

#### **1.4.3. Supplementation studies (Table 1.4.8.)**

I located ten supplementation studies that aimed at preventing malnutrition in women and or children and looked at the effects of supplementation on children's development. Of these 3 involved pregnant mothers only, 4 supplemented pregnant mothers and their offspring and the other 3 involved nutritionally at risk children only. Two of the studies included groups with psychosocial stimulation (Waber et al. 1981; Grantham-McGregor et al. 1991). Three of the studies were conducted in developed countries and the rest in developing countries.

##### *Supplementation to mothers only*

1. Pencharz and colleagues assessed the effect of dietary supplements given to pregnant women in Montreal on the school performance of their children (Pencharz et al. 1983). The children were matched with a group of retrospectively selected children on the basis of race, religion, birth order, birth timing and mothers' pre-pregnancy weight. Another comparison group

included the next older and next younger siblings. This study showed that in French schools there was no significant difference between the cases, siblings and controls. In English schools the cases performed significantly worse than the siblings and matched controls on the reading test. This study had a substantial loss of subjects and could only trace 61% of the total sample.

2. In New York, Rush and colleagues examined the effect of maternal nutritional supplementation on postnatal development of infants. Poor black pregnant women received either a *supplement* containing high protein, energy, vitamins, and minerals, or a *complement* consisting low protein and energy and were compared with a non-intervened (control) group based on random allocation. The supplement showed beneficial effects on measures of habituation, dishabituation and length of free play episodes, when the infants were tested at 1 year of age, but no effects on developmental tests measured by Bayley's mental and psychomotor indices, object permanence and sophistication of play was observed (Rush et al. 1980).
3. The Bacon Chow study in Taiwan randomised pregnant mothers to supplement or placebo through out pregnancy and lactation and compared their infants at 8 months of age. . The subjects were all from the lowest economic status backgrounds. There was no difference between the two groups of infants in mental development but the supplemented group was significantly better in their motor development than the non-supplemented group (Joos et al. 1983). However when the children were tested at 5 years of age there was no benefit to their IQs (Hsueh and Myer 1981).

#### *Supplementation in pregnancy and early childhood*

1. A study in Louisiana involved 21 pairs of siblings from 3 rural parishes who participated in early (prenatally from third trimester of gestation to 56 months) or late (from one year onwards for an average of 31 months) supplementation in the Women, Infant and Children (WIC) programme. The paired children coming from the same families were different in birth order, but the design controlled for a number of variables like parental education and IQ, socio-economic status, parenting style and materials in the home. The early supplemented children at 6 years of age scored significantly better in IQ tests

than the late supplemented children at 8 years of age (Hicks et al. 1982). However, the different age at testing may affect the results. The children in the early supplemented group also had significantly greater height-for-age.

2. A Mexican study supplemented 17 children since early prenatal life till 3 years of age from a poor village and compared them with 17 non-intervened children who were born the previous year. When the children were tested at school age, the supplemented children had better school grades, more correct answers, better behaviour and slightly higher IQ than the non-supplemented children (Chavez and Martinez 1981). Though the study was small, non-randomised and the supplemented groups were separated by time, at 18-years of age the supplemented boys had higher scores on Raven's Progressive Matrices Test than the non-supplemented boys; there was no difference between the girls in the two groups (Chavez et al 1994).
3. The Institute of Nutrition of Central America and Panama (INCAP)'s longitudinal study in Guatemala supplemented pregnant and lactating mothers and their children up to 7 years of age in four small Guatemalan villages. Two of the villages were given a high protein-calorie supplement and the other 2 received a low calorie supplement. At 3-4 years of age, the children receiving the high protein-calorie supplement had better nutritional status and higher scores on cognitive tests (Freeman et al. 1977). When the children were tested at school age (6-8 years), those who received more of the high calorie supplement had more exploratory behaviour, greater persistence, and better motor impulse control than those who received less. They were also happier, less anxious and more initiative (Barrett and Radke-Yarrow 1985). For the purpose of this analysis the authors broke the randomised design and the analysis was conducted on the basis of the amount of supplementation that the children received in three out of four villages only. When followed up at 11-24 years of age children from the high calorie and protein villages had small but wide ranging benefits in tests of numeracy, knowledge, vocabulary, and reading achievements. They had faster reaction time in information-processing tasks and the poorest children in the sample were benefited most from the supplementation (Pollitt et al. 1993).

4. In a study in Bogota, Colombia families were randomly assigned to one of the six groups. Two groups received stimulation and are discussed later. The other four groups consisted of a control group who did not receive any intervention, and three groups received food supplementation either from the last trimester of pregnancy till three years of age, from third trimester until 6 months postnatally only, or from 6 months to three years of age. The children receiving food supplementation performed better than those who were not supplemented in locomotor, personal-social, speech and language, eye-hand co-ordination and performance. Supplementation benefited locomotor function first, other functions were affected later (Waber et al. 1981). The effects were more pronounced for girls than boys. The performance of the group who was supplemented early i.e. prenatally and until six months of age was similar to the control group once the supplementation was stopped at 6 months. On the other hand the performance of the group who were supplemented throughout the study period did not differ from that of those who were supplemented after 6 months of age. The latter 2 groups performed better than the control and the group stopping supplementation at 6 months of age. At seven years of age the children supplemented for at least 30 months showed higher scores on reading readiness (Super et al. 1991).

#### *Supplementation of children only*

1. Day Care Centres of the Indonesia's tea plantations were randomly allocated to nutritional supplementation and controls. The nutritionally at risk children at 6-59 months of age who participated in the programme were assessed for their growth and development at the end of 90 days of intervention. Supplementation had no effect on children's height or their mental development (Fig. 1.4.1.) but there were significant effects on body weight and motor development (Fig. 1.4.2.) of the children below 20 months of age (Husaini et al. 1991). When they were revisited 8 years later, the supplementation had a benefit on memory of the children who received the supplements before the age of 18 months but not on children who received the supplementation at an older age (Pollitt et al. 1997).

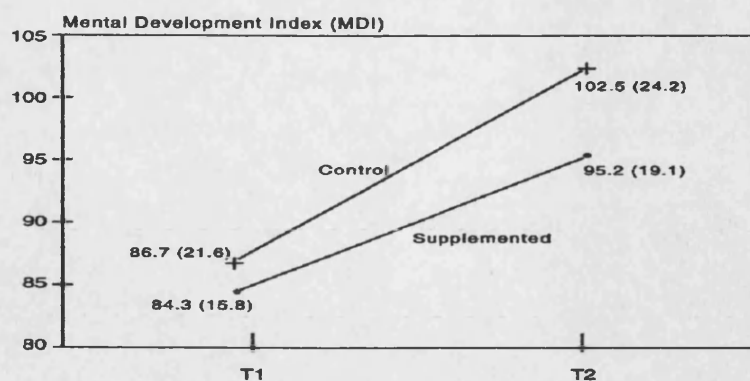


Figure 1.4.1. Mental Development Index of the Indonesian children mean (SD) before (T1) and after (T2) treatment.

Husaini 1991

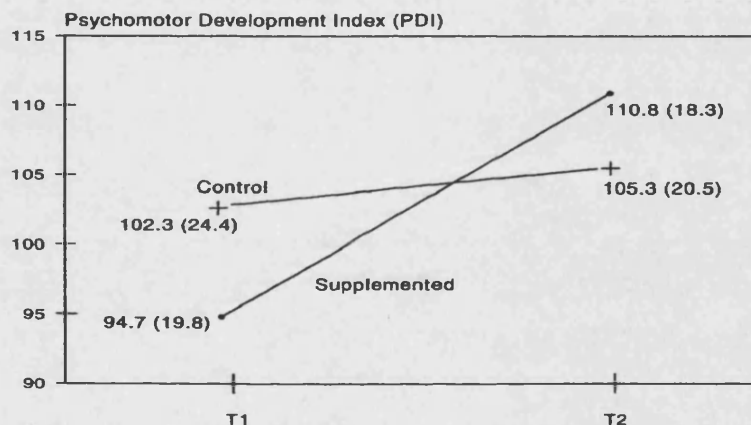


Figure 1.4.2. Psychomotor Development Index of the Indonesian children mean (SD) before (T1) and after (T2) treatment.

Husaini 1991

2. In another Indonesian study two cohorts of children from day-care centres of six tea plantations were randomly assigned to receive a supplement containing high energy and micronutrient, low energy and micronutrient or low energy alone for 12 months. The first cohort comprised of children who were 12 months old and the children in the second cohort were 18 months old. The subjects in the high energy and micronutrient group walked at an earlier age, had higher scores on motor scale of Bayley (Jahari et al. 2000), and were more active, they also had more mature social-cognitive and emotional regulatory

behaviours (Pollitt et al. 2000). This indicated benefits from supplemental energy.

3. A Jamaican study assessed the effects of supplementation, stimulation, both treatments or none in stunted children. They were also compared with a fifth group of matched adequately nourished children. The findings showed independent benefits of supplementation and stimulation on development of the children. The benefits were additive and the children receiving both treatments caught up to the non-stunted control group in their developmental levels (Grantham-McGregor et al. 1991). When the children were followed up at 7-8 years of age (Grantham-McGregor et al. 1997) each intervention group had higher scores than the non-intervened group but there was no longer an additive effect of the treatments. At 11-12 years (Walker et al. 2000) of age no benefit from supplementation remained but there was a small but significant benefit from stimulation on cognition.

**Table 1.4.8. Studies of the effect of food supplementation on development of children**

Author, year, country	Subjects	Study design	Duration of supplementation	Results
Rush, 1980 New York	Pregnant mothers	RCT 3 groups; supplement, complement, control	<30 weeks of pregnancy till delivery	Benefits on habituation, dishabituation, increased length of free play, in the supplemented group at one year of age.  No effect on developmental tests.
Pencharz, 1983 Montreal, Canada	Pregnant mothers	Cases: children whose mothers received supplements during pregnancy. Controls: Retrospectively matched controls, and next older and next younger siblings tested at school-age	Pregnancy	In the French schools: no significant difference between the cases, siblings and the controls.  In the English schools: cases performed significantly worse than the siblings and matched controls on the reading test.
Joos, 1983, Hsueh, 1981 Taiwan	Pregnant and lactating mothers	RCT 2 groups; supplement and placebo	Supplemented throughout pregnancy and lactation	Better motor scores at 8 months.  No effect found at 5 years on IQ.

RCT = randomised controlled trial



**Table 1.4.8. (Contd.) Studies of the effect of food supplementation on development of children**

Author, year, country	Subjects	Study design	Duration of supplementation	Results
Hicks 1982 Louisiana	Mothers & two children- each	Cases: Children supplemented from pregnancy Controls: siblings supplemented from 12 months Cases tested at 6 years and controls at 8 years of age	Younger children supplemented from pregnancy and for 56 months, older children from 12 months for 30 months	IQ benefits in younger children.
Freeman, 1977 Barrett, 1985 Pollitt, 1993 Guatemala	Mother & child	4 villages randomised to high calorie and protein or low calorie supplement	Pregnancy & lactation Children: up to 7 years	IQ benefits at 3-4 years. More exploration and behavioural differences at school age. At 11-24 years benefits in numeracy, knowledge, reading, vocabulary and faster reaction time
Chavez, 1981, 1994 Mexico	Mother & child	Supplemented group born one year later than control group in same village	Pregnancy & lactation Child till 7 years	IQ benefit, increase in activity, better school grades. At 18-years of age the supplemented boys had higher scores on Raven's Matrices Test
Waber, 1981 Super, 1991 Bogota, Columbia	Mother &/or child	RCT with 6 groups: 1. Control, 2. Supplemented from pregnancy to 6 months of age, 3. Supplemented from 6 to 36 months, 4. Supplemented from pregnancy to 36 months, See Table 1.4.9 for other 2 groups	Mothers from 3 <sup>rd</sup> trimester through lactation Children: birth to 3 years or 6 months to 3 years	Benefit in motor function & school readiness from supplementation.  Similar performance in groups 3 & 4.  No difference between groups 1 & 2.

RCT = randomised controlled trial

**Table 1.4.8. (Contd.) Studies of the effect of food supplementation on development of children**

Author, year, country	Subjects	Study design	Duration of supplementation	Results
Husaini, 1991, Pollitt, 1997 Indonesia	Children 6-59 months	RCT 2 groups: 1. Supplement 2. No supplement	90 days	Benefit in motor function if supplemented before 20 months of age. Follow up at 8 years: Benefits in memory for those supplemented before 18 months of age.
Grantham-McGregor, 1991, 1997 Walker, 2000 Jamaica	Stunted children 9-24 months	RCT 4 groups: 1. Stimulated 2. Supplemented 3. Both 4. Control 5. A group of non-stunted children matched for age & sex	24 months	Benefits of supplementation at the end of intervention, & at 7 years of age on DQ, No benefit of supplementation at 11-12 years
Pollitt, 2000, Jehari, 2000 Indonesia	2 cohorts of children at 12 and 18 months in day care	RCT 3 groups: 1. High energy + micronutrients, 2. Low energy + micronutrients, 3. Low energy	12 months	Benefit in mental, motor & behaviour in high energy + micronutrient group.

RCT = randomised controlled trial

### **Discussion of food supplementation trials:**

Of the three studies involving supplementing mothers only, one study showed no effect of supplementation and that study suffered a great loss and was not a randomised-controlled trial (Pencharz et al. 1983). Furthermore it was in a developed country and the women may not have been nutritionally at risk. The other two studies of supplementing mothers alone showed some benefits (Joos et al. 1983; Rush et al. 1980) however neither reported a long term benefit.

In all studies involving supplementation of the child, the children showed concurrent benefits on their development. In Indonesia, only motor and not mental development of children benefited however, the children were supplemented for only three months (Husaini et al. 1991).

### *Long-term benefits*

Of the three studies involving supplementing mothers in pregnancy and the children in early childhood all showed some benefit at follow up. One followed them up only to school entrance (Super et al. 1991) but two studies followed up to late adolescence (Chavez et al. 1994; Pollitt et al. 1993). The Mexican study showed benefits in boys' IQ only (Chavez et al. 1994) whereas the Guatemalan study found small benefits to a wide range of tests (Pollitt et al. 1993).

Two studies in Jamaica and Indonesia that began supplementation when the children were already undernourished reported following up the children and sustained benefits were less likely. In the Jamaican study benefits disappeared after 7 years of age (Walker et al. 2000) and in Indonesia only children who received supplement before 18 months showed benefits in one test of memory (Pollitt et al. 1997).

### *Design problems*

There were problems with the design of many of the studies. Several were not randomised. The Mexican study was not randomised and the two groups were separated by time (Chavez and Martinez 1981). The Louisiana study (Hicks et al. 1982) compared siblings but they were tested at different ages. Although the Guatemalan study was randomised the unit of randomisation was village and there

were only four villages (Freeman et al. 1977). However, most of the more recent studies were randomised.

Several studies made no attempt at providing a placebo. The Taiwan study (Joos et al. 1983) was one of the few that had a true placebo. In the Indonesian study all the groups received some supplementation (Jahari et al. 2000; Pollitt et al. 2000), and the Guatemalan one had a low calorie drink for a placebo but consumption of the high and low calorie drinks varied so it was not a perfect placebo.

A further complication is that the families were fed in some studies and may thus have behaved differently towards the children. The growth response was small in some studies and it is likely that sharing of the supplement occurred when supplement was given at home (Grantham-McGregor 1993). This would reduce the effects of supplementation.

#### *Conclusions from supplementation studies*

Problems in the design of some of the studies make it difficult to draw unequivocal conclusions. However, the results from concurrent supplementation in the first 3 years are consistently positive and it therefore seems reasonably certain that concurrent malnutrition produces deficits in behaviour, mental and motor development. Long-term benefits are less well established although the evidence is increasing. It seems that long-term benefits are most likely to occur if supplement begins in pregnancy and continues for two to three years. However more well designed randomised trials with long-term follow up are needed.

Most malnourished children come from poorer families with less educated parents and fewer opportunities for psychosocial stimulation. Therefore, supplementation alone may not be the complete answer to the treatment of malnutrition and some improvement to the environment may be necessary.

#### 1.4.4. Stimulation studies (Table 1.4.9.)

Several studies have added psychosocial stimulation to the treatment of malnourished children. These studies were one each in Lebanon and Chile and two each in Jamaica and Columbia. There was also one with failure to thrive children in the USA.

1. In Lebanon severely malnourished children between ages 2½ and 16 months who were admitted to the Clinical Nutrition Unit of Beirut were assigned to either a stimulated or an un-stimulated group after matching for age and sex. The children stayed for at least 4 months in the hospital. The stimulated group improved significantly more than the un-stimulated malnourished group (Fig. 1.4.3.) by the time they were leaving the hospital (Yaktin and McLaren 1970). However, the effect did not persist one year after discharge from the hospital (Yaktin et al. 1971). Three to 4 years later the un-stimulated group had significantly higher scores than the stimulated group (McLaren et al. 1973). The living conditions and the SES of the stimulated group were found to be worse than the un-stimulated group, and this had possibly given rise to this difference in their IQ.

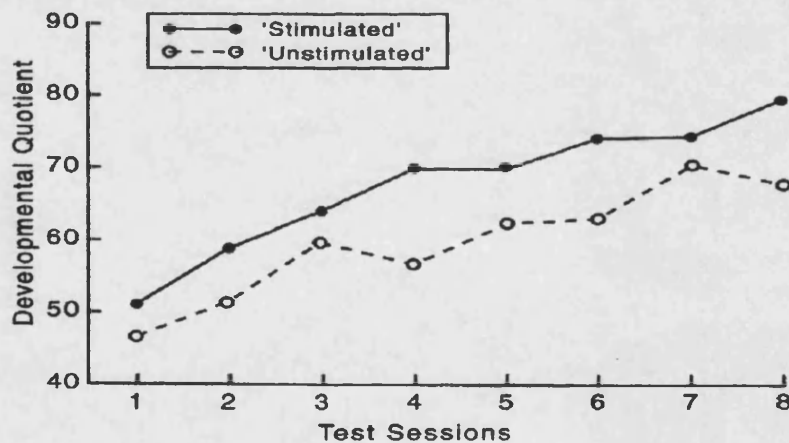


Figure 1.4.3. Developmental quotient during recovery in stimulated and un-stimulated groups in hospital.

Yaktin and McLaren 1970

2. A project in Chile was conducted by Monckeberg (1979) that in addition to food supplementation to malnourished children provided an hour of early psychosensory stimulation and an hour of physical exercise every day, and affective stimulation throughout the day in the hospital. Their mothers were also trained in care and stimulation of their children and the family was rehabilitated through educational programmes, job training, treatment and prevention of alcoholism and enhancing self-esteem of parents. The 1<sup>st</sup> eighty infants with severe malnutrition who were admitted to the paediatric unit of the treatment centre were enrolled in the programme and were compared with 80 infants admitted to a Santiago hospital receiving traditional treatment techniques. All the infants had a low average birth weight, severe malnutrition beginning early in the 1<sup>st</sup> half of the 1<sup>st</sup> year of life and delayed psychomotor development on admission. The infants remained in the treatment centre for an average of 140 days and were followed up at home for 6 months or longer. The children in the control group were not followed up after discharge. Results showed that at the end of 4 months the stimulated infants had significantly higher weight and height gains as well as psychomotor development. Frequency of intercurrent infections and mortality was also significantly lower in the stimulated children. Children who received treatment at an earlier age developed significantly more than those who were admitted after 6 months of age in their psychomotor DQ. One problem with interpreting these results is that the treatment centre offered much better nutritional and health care in addition to stimulation.
3. A Jamaican study (Grantham-McGregor et al. 1983) differed from the above in that children hospitalised for severe malnutrition received psychosocial stimulation in hospital but also continued in the programme after they returned home. They received weekly home visits for two years followed by visits every two weeks for a third year. The children were compared with a similar group who received standard care only and were admitted to the same hospital the previous year. There was a third group of children who were adequately nourished but were hospitalised for other illnesses. The intervention group was separated from the other 2 groups by time, but they were matched for age,

housing and maternal education. Both the malnourished groups had significantly poorer DQs than the adequately nourished group on enrolment. The intervened children's DQ significantly improved while still in hospital and after 6 months they were ahead of the control malnourished children and not significantly behind the adequately nourished children anymore (Grantham-McGregor et al. 1980). By 24 months they were even ahead of the adequately nourished children in performance and hearing and speech sub-scales of the Griffiths test and were similar to them in hand and eye co-ordination sub-scale and DQ (Grantham-McGregor et al. 1983). Their locomotor development however remained significantly lower than the adequately nourished children but significantly better than the non-intervened malnourished children. When the children were followed up six (Grantham-McGregor et al. 1987) and 14 years (Grantham-McGregor et al. 1994) after the programme had ended they showed significant benefits to their IQ from psychosocial stimulation (Fig 1.4.4.).

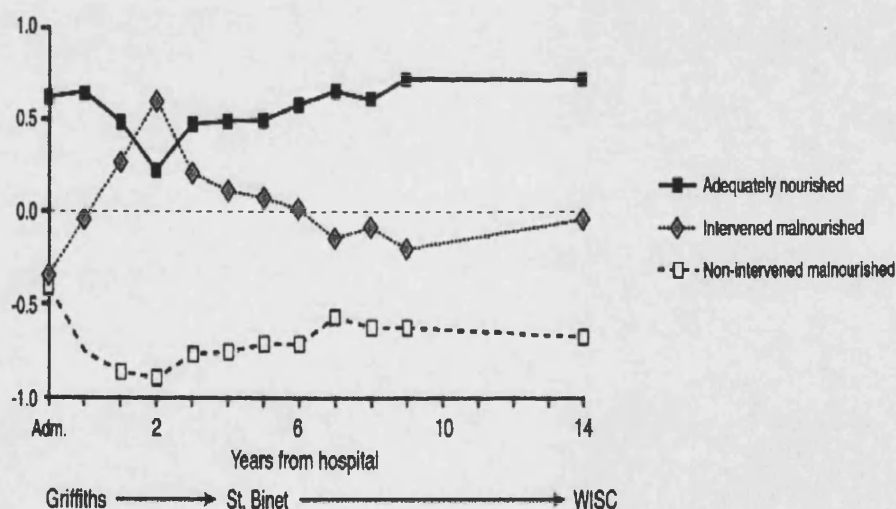


Figure 1.4.4. Developmental Levels of Severely Malnourished Jamaican Children until Adolescence

Grantham-McGregor et al. 1994

4. Another Jamaican study described above assessed the effects of supplementation, stimulation, both treatments or none in stunted children (Grantham-McGregor et al. 1991). They were also compared with a fifth group of matched adequately nourished children. Stimulation produced significant benefits at the end of the intervention (Fig 1.4.5.) and some cognitive benefits were present at 12 years of age (Walker et al. 2000). A very recent follow-up at 17 years of age still showed benefits in cognition, school achievement and psychosocial function from stimulation (Grantham-McGregor, personal communication).

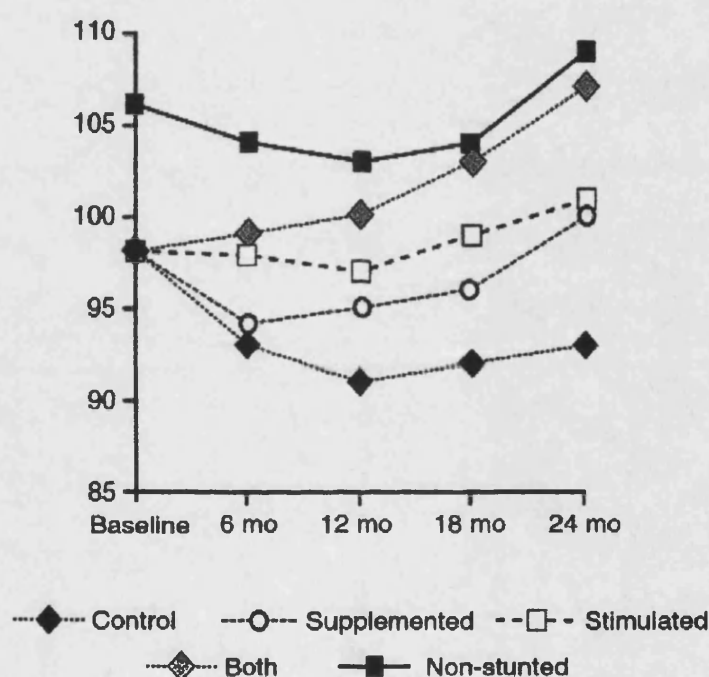


Figure 1.4.5. Mean Developmental Quotients of Stunted (adjusted for initial age and score) and non-stunted Jamaican Children (adjusted for age only) from Baseline to 24 Months by Intervention Status

Grantham-McGregor et al. 1991



5. The Colombian study in Cali combined 3 types of interventions namely nutritional supplementation, health care and educational stimulation in undernourished preschool children. The children were enrolled at 3.5 to 7 years of age. The treatment included educational activities of approximately four hours a day, food supplementation of a minimum of 75% of the recommended dietary allowance for protein and calorie, with added vitamins and minerals, offered *ad libitum*, and health check-up and treatment of infections. There were four treatment groups receiving one to four treatment periods of approximately nine months. The supplemented children were compared to two groups of adequately nourished children; one from a similar SES and the other from a higher SES. The intervened groups showed improved cognitive test performance and the earlier the intervention began and the longer it continued the greater were the improvements in cognition of the children (Figs. 1.4.6. & 1.4.7.) (McKay et al. 1978).

6.

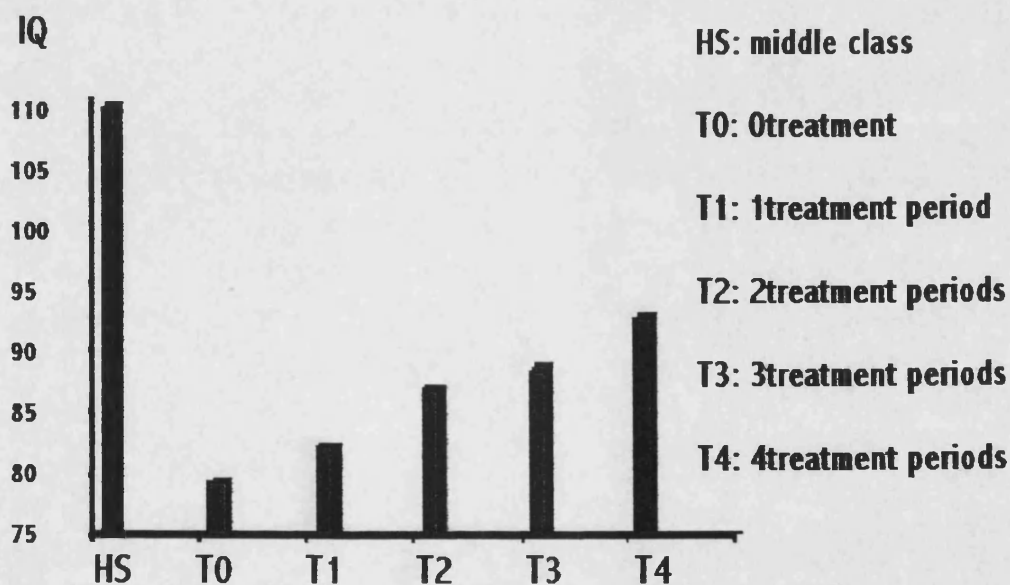


Figure 1.4.6. Dose-response effect on child IQ of a Combined Health, Nutrition and Stimulation Intervention at 7 years of age in Cali, Columbia.  
McKay et al. 1978

Benefits were sustained for at least three years following intervention. The study had no malnourished group that did not receive any intervention and it was not possible to separate the effects of supplementation from stimulation. The duration of the intervention varied with the age of the children at enrolment (McKay and McKay 1983).

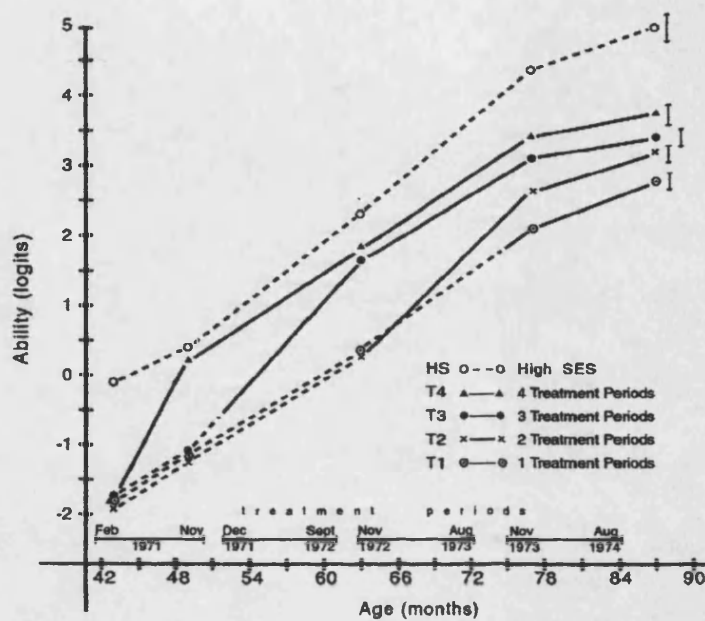


Figure 1.4.7. Growth of general ability of the children from 43 to 87 months, the age at the beginning of primary school. The solid lines represent periods of participation in a treatment sequence.

McKay et al. 1978

7. In the Bogota study described above under "Supplementation studies" (Waber et al. 1981) two more groups of children who received stimulation were also examined in addition to the previously mentioned supplemented ones. One group received stimulation from birth to 36 months and was also supplemented with food prenatally till three years of age, the other group received only stimulation from birth to 36 months of age. All study groups are shown in the figure 1.4.8. The stimulation programme included a twice-weekly home-visiting programme of cognitive development. The supplementation effect was significant for perceptual analysis while stimulation had a significant effect on perceptual analysis and language (Mora et al. 1981).

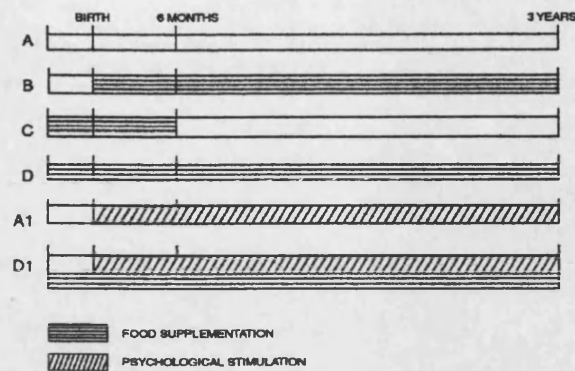


Figure 1.4.8. Intervention schedule for the experimental groups in Bogota, Columbia.

Mora et al. 1981

8. Black and colleagues conducted a home intervention programme for the children with non-organic failure to thrive (FTT) in USA. They included children below 25 months of age and randomly allocated them and their mothers to either a weekly home visits for one year or usual attendance in clinic only. All the children received food supplementation. They found better receptive language and more child-oriented home environments in the intervention group. There was no effect on motor development of the children while cognitive benefits were only observed in the children who received the intervention when they were less than 12 months of age (Black et al. 1995).

**Table 1.4.9. Studies on the effect of psychosocial stimulation on development of malnourished children**

Author, year, country	Subjects	Study design	Duration	Result
Yaktin, 1970, 1971 McLaren, 1973 Lebanon	Severely malnourished children in hospital	Cases: Usual nutritional care with stimulation activities Controls: Matched for age and sex with usual nutritional care only	During hospital stay-at least 4 months	Significant positive effect of stimulation at discharge No effect after 1 year Significant negative effect of stimulation after 3-4 years
McKay, 1978, 1983 Cali, Columbia	Undernourished preschool children 3.5-7 years	Random assignment of children to 1, 2, 3, or 4 treatment periods of 9 months each. Two matched groups of adequately nourished children from high and low SES families.	Up to 4 treatment periods of health, nutrition and cognitive intervention	Benefits on development & school achievement related to the length of intervention. Benefits were sustained for at least 3 years. Low SES and High SES controls had significantly lower and higher scores than all the other groups respectively.
Monckeberg, 1979, Chile	Severely malnourished infants in 1 <sup>st</sup> half of the 1 <sup>st</sup> year of life	Non-random assignment Control: receiving nutrition and medical care at a hospital Intervention: nutrition, medical care, physical exercise, psychosensory and affective stimulation at a treatment centre	On average 140 days	Intervention significantly benefited growth, DQ, morbidity and mortality.
Mora, 1981 Bogota, Columbia Same study as in Table 1.4.8.	Mothers with children at risk of malnutrition	RCT with 6 groups: 1 to 4 in Table 1.4.8. 5. Twice weekly home visits 6. Food supplementation prenatally to 3 years + home visits	From birth to 3 years	Benefits on perceptual analysis and language from stimulation and on perceptual analysis from supplementation at 36 months

RCT = randomised controlled trial

**Table 1.4.9. (Contd.) Studies on the effect of psychosocial stimulation on development of malnourished children**

Author, year, country	Subjects	Study design	Duration	Result
Grantham-McGregor, 1980, 1983, 1987, 1994 Jamaica	Severe PEM in hospital 6-24 months	Stimulated group compared with similar children admitted to the same hospital the previous year	1 hour play in hospital /day, then weekly home visits for 2 years, then 2 weekly for 1 year, no supplement	Benefits in IQ and school achievement up to 14 years after discharge.
Grantham-McGregor, 1991, Walker, 2000 Jamaica	Stunted children 9-24 months	RCT, 4 groups: 1. Stimulated 2. Supplemented 3. Both 4. Control	24 months	Concurrent independent benefits of supplementation & stimulation.  At 7 years: small global benefits of both treatments.  Long-term benefit of stimulation only at 11-12 years.
Black, 1995 Maryland, USA	Non-organic failure to thrive, age <25 months	RCT, two groups: 1. Paediatric primary care clinic only, 2. Clinic + home visits	Food supplementation with or without weekly home visits for one year	Home visits showed better receptive language and more child-oriented home.  Cognitive benefits observed only in children <12 months when intervention started.  No effects on motor function.

RCT = randomised controlled trial

### **Discussion on stimulation studies**

All seven studies, which included stimulation, had some concurrent benefit to the children's development. The Lebanese study showed a small effect of stimulation at discharge but the result was reversed after 3-4 years of discharge and the development of the children were shown to be more affected by the environmental factors. It is likely that stimulation in hospital alone is too short a period to have sustained effects. The size of each group was also small. The study in Chile showed striking short-term results but treatment was not randomised and the treatment of the stimulated group was superior in many other ways. The benefits may have occurred due to medical and nutritional care differences between the two groups. They did not report long-term follow up.

In the remaining studies the interventions lasted longer and all found some long-term benefits. In the Cali study there was no control malnourished group but the effect of intervention was evaluated by comparing groups with different duration and age at beginning of intervention (McKay et al. 1978). The study randomised allocation to groups by geographical locations and not by individual children, however it provided valuable information that the longer the intervention, the greater were the benefits. In the Bogota study significant effect of stimulation on cognition was shown through a strong randomised design (Mora et al. 1981).

The 2 Jamaican studies had benefits up to late adolescence from stimulation. In the first study of severely malnourished children in the hospital (Grantham-McGregor et al. 1980;1983;1987;1994) the intervened children were separated from the other two groups by time and this may have contributed to the differences but they were matched for age, housing and maternal education. However, the findings of long-term benefits were replicated in the second Jamaican study, that had one of the better designs and a good follow-up (Grantham-McGregor et al. 1991;Walker et al. 2000). It had a randomised design with pre intervention measures showing equivalence among the groups. The intervention lasted two years. Only two of the studies separated the effects of supplementation from stimulation (Grantham-McGregor et al. 1991;Mora et al. 1981) and it was not possible to identify the independent roles of each in other studies. It may be concluded that nutritional supplementation combined with psychosocial stimulation seems an appropriate plan for the holistic treatment of malnourished children.

## **1.5. REVIEW OF THE LITERATURE ON MALNUTRITION AND BEHAVIOUR**

There are a few studies that have looked at the behaviour of the malnourished children in the acute stage and some have also followed up these children when they were at school age. Other studies have looked at the behaviour of moderately malnourished children and very few have assessed the effect of supplementation on behaviour.

### **1.5.1. Concurrent effects**

In a review of the effects of severe malnutrition on children's development Grantham-McGregor refers to some studies that showed severely malnourished children in the acute stage in hospital to be less active and explorative, more apathetic, and irritable when disturbed (Grantham-McGregor 1995) than other children admitted to hospital with other diseases. However it was observed that once their nutritional status improved the children's behaviour also improved in all the dimensions except in the quality of explorations (Grantham-McGregor 1995). This was in contrast to their developmental levels, which showed no sign of catching up to adequately nourished group.

Moderately malnourished children have also shown behaviour differences from adequately nourished ones. Graves conducted 2 similar studies in West Bengal and Nepal to compare the behaviour of moderately malnourished and well-nourished children in the community. The malnourished children in Nepal spent less time in play, showed lower level of exploratory behaviour, and wanted to be close to their mothers more frequently (Graves 1978). The malnourished boys in West Bengal had similar behavioural characteristics. They showed less enthusiasm in play and preferred to stay close to their mothers (Graves 1976). In a study of Kenyan toddlers the better nourished toddlers were more vocal and playful and engaged in more symbolic play than their undernourished peers (Sigman et al. 1989). In a review of the Nutrition Collaborative Research Support Programme studies, the stunted children in Egypt, Mexico and Kenya were found to show more apathy, cry more and smile less, they spent more time close to adults and most of the time did nothing and had less interaction with others (Allen 1993). In Jamaica moderately stunted children were more apathetic, showed less enthusiasm in exploration of the

environment, less happiness and more fussiness than the non-stunted children and were less active. Furthermore, the quality of their mothers' vocalisations to the child was poorer (Meeks-Gardner et al. 1999). All of the above studies were observational and it always remains possible that other factors in the environment associated with poverty are responsible for the behavioural differences.

Studies of supplementation should provide stronger evidence of a causal relationship however, there is very little data on behaviour from these studies. In a study in a village in Mexico, 17 children who were not supplemented were compared with a group of children who were born into the same village the following year and received supplementation. The supplemented children were less fussy, cried less, vocalised more and explored the environment more than the non-supplemented children (Chavez and Martinez 1982). It is hypothesised that children's behaviour produces reciprocal responses from their carers and the mothers of the supplemented children were more responsive to their children. However, the groups were very small and separated by time and it is possible that other changes occurred in the village that may have affected the behaviour.

In contrast to the Mexican study, the Jamaican study was a randomised controlled trial and supplementation did not affect the stunted children's behaviour (Meeks-Gardner et al. 1999). In a recent study, undernourished Indonesian children were randomised to three different supplementation groups; high energy and micronutrient, low energy and micronutrient, and low energy only. The children in the high energy supplemented group vocalised and played more and cried and fussed less than the low energy group (Pollitt et al. 2000). When their play behaviour was observed children in the high-energy group waited less time than the other two groups to begin play and girls had increased functional play which meant that they used at least one object in such a way that corresponded to its function during the play observation (Walka et al. 2000). The activity level of the children who began receiving supplementation at 12 months was increased in the high energy supplemented children than the other two groups but no difference was observed in those who received supplements at 18 months of age (Jahari et al. 2000). It is clear that the high energy group benefited but the role of micronutrients is less clear.



### **1.5.2. Effect of malnutrition on behaviour in school aged children**

A cohort of moderately stunted Jamaican children aged 8.5 to 10 years were more inhibited and less happy and tended to talk less and be less persistent during a set task than non-stunted children (Fernald and Grantham-McGregor 2002). The long-term effect of malnutrition in early childhood on later behaviour was examined in a few studies. In Jamaica the children who were stunted before 24 months of age were examined at 7-8 years of age and they were less vocal, more inhibited and had poorer attention (Fernald and Grantham-McGregor 1998). They were also reported by their mothers to have more conduct disorders at 11-12 years of age (Chang et al. 2002). In Barbados the mothers and teachers of children with a history of malnutrition in infancy were interviewed concerning their children's behaviour at 5-11 (Galler et al. 1985b) and 9-15 (Galler and Ramsey 1989) years of age. The previously malnourished children showed attention deficit and had poorer social skills in school. They also showed more aggression and were more distractible at home. Another group of previously malnourished children in Jamaica was observed for their interaction with their mothers approximately 3 years after recovery from malnutrition (Grantham-McGregor et al. 1989b). They were about 4 years of age at the time of testing. The previously malnourished children played less and stayed closer to their mothers than children never undernourished. A second group of malnourished children who participated in a stimulation programme were not different from the adequately nourished group.

I located only one study of supplementation in early childhood that looked at the behaviour of the children at school age. Children in a quasi-experimental study in Guatemala were examined for their behaviour and ability to respond to stressful situations at 6-8 years of age. The children who received high supplementation were compared with the children who received little supplementation in early childhood. The high supplementation children were found to have more interest in their environment and were more exploratory in a novel surrounding than those in the low supplementation group. They also participated more in competitive games and showed greater persistence in solving frustrating tasks. Those in the low-supplementation group had poorer control of motor impulses and showed less initiative. Their play behaviour was poorer, they were less happy, less active and had poorer social involvement (Barrett and Radke-Yarrow 1985).

### **1.5.3. Conclusion from behaviour studies**

The findings are consistent in that malnourished children are less active and exploratory, tend to be nearer their mothers, and be more fussy, fearful, and less happy. The children continue to show behaviour problems at school age. However, the studies are mostly observational and it is possible that other factors such as unstimulating environments could contribute to this behaviour. For example, one Jamaican study showed improvement in these behaviours following participation in a stimulation programme despite there being no improvement in the children's nutritional status (Grantham-McGregor et al. 1989b). In three supplementation studies (Barrett and Radke-Yarrow 1985; Pollitt et al. 2000; Chavez and Martinez 1982) supplemented children showed an improvement in their behaviour whereas only one study found no effect (Meeks-Gardner et al. 1999). There is therefore some evidence that early childhood malnutrition at least contributes to behavioural changes that may persist to adolescence unless otherwise treated. Child's behaviour is thought to initiate reciprocal unstimulating behaviour in the caretaker and the caretaker's behaviour may contribute to the children's continuing poor cognitive development. Although several studies have shown that caretakers of malnourished children have less stimulating behaviour it is unclear whether this precedes or follows child malnutrition.

## **1.6. VULNERABLE PERIOD**

Since maximum brain growth occurs during the last trimester of pregnancy and first 2-3 years of postnatal life, it is postulated that any insult at this period is more harmful and has long lasting effect on cognition and behaviour.

### *Animal studies*

Experimental animal studies have shown evidence of a sensitive period during which nutritional insult causes damage to the anatomy and functioning of brain. Neonatal malnutrition resulted in a reduction in volume and width of the cerebral cortex, decrease in density of cortical dendritic spines, and the complexity of its dendritic branching. The number of cortical neurons and the density of cortical synapses were however not affected (Levitsky and Strupp 1995). Nutritional rehabilitation of these malnourished animals has shown some of the changes to be reversed but not all. For example the period of mitotic activity of cortex was prolonged in rats allowing for maximal brain protein synthesis and the reduction in the size of brain that normally occurs in well-nourished rats occurred much later in malnourished rats. On the other hand the decrease in brain myelination and lower number of cortical dendrites in synaptic spines remained unaffected by rehabilitation.

### *Studies in humans*

Some observational studies have shown that malnutrition earlier in life have more enduring effects than later episodes. Drewett compared children who developed malnutrition before 4 months of age with those who became malnourished at 10-12 months of age and found that the early growth falterers were significantly behind the late growth falterers in their development at 2 years of age (Drewett et al. 2001). Height in early childhood predicted cognitive development at a later age as evidenced in a few studies. In Guatemala (Martorell et al. 1992) children's height at 3 years of age was predictive of their performance on tests of numeracy, literacy, general knowledge, and school grades. In Kenya (Sigman et al. 1991) children's height at 18-30 months of age predicted their cognitive scores at 5 years of age. Jamaican girls' height at one year of age predicted their school achievement at 9 and 11 years of age (Richardson 1979) and in another study in Jamaica children's

height-for-age at 9-24 months of age was more predictive of their IQ at 7 years of age than their concurrent height (Grantham-McGregor et al. 1997).

Supplementation studies have shown better and more sustained benefits to cognition with early rather than later supplementation. For example in Guatemala children receiving supplements for the first 24 months of age had more benefits at adolescence to their cognition than those receiving the supplements after 24 months (Pollitt et al. 1993), however, the number of children over 24 months of age was fewer in that study. An analysis of experimental and quasi-experimental supplementation studies demonstrated that supplementation during pregnancy and the first two years improved motor development of infants at 8-12 months and mental and motor development of toddlers at a later age (12-24 months) (Pollitt and Oh 1994). However in a subsequent Indonesian study, children who were supplemented before 20 months of age showed benefits in development but those receiving supplements at an older age did not (Husaini et al. 1991). Follow up at 8 years of age found that only children who received supplements before 18 months had benefits in working memory (Pollitt et al. 1997).

In contrast in Cali, Columbia undernourished children receiving supplements from 42 months of age showed no benefit. In the same study other groups of children received both supplementation and stimulation for varying periods of time. Those beginning at the youngest age (42 months) showed greatest and more sustained benefits (McKay et al. 1978) but all children received both supplementation and stimulation and therefore, it was not possible to determine whether supplementation added any benefit to stimulation. Moreover the duration of the supplement differed with the age of children and younger children received treatment for longer duration.

Evidence for a vulnerable age is therefore not conclusive but there is a suggestion that malnutrition in first 2 years of life is more likely to affect the long-term development of children than malnutrition at a later age

## **1.7. MECHANISMS LINKING POOR DEVELOPMENT TO MALNUTRITION**

The exact mechanism linking malnutrition and poor mental development is not yet fully known. Previously it was thought that malnutrition caused brain damage and this in turn resulted in delayed mental development of children. Many scientists thought that malnutrition led to permanent brain damage with consequent irreversible impaired function. There are at present, several postulations about the possible mechanisms. Broadly there are two main categories, those linked to the child's behaviour or size, that subsequently alter the carer's behaviour and those directly linked to changes in the child's central nervous system referred to above.

### *Child's behaviour*

"Functional isolation hypothesis" is one of the mechanisms suggested by Levitsky (1979). Malnourished children are usually lethargic, less exploring, less active and more apathetic. This may limit their interactions with the environment and under normal conditions it is through interacting with the environment that the children develop their skills.

Malnourished children usually suffer from repeated episodes of infection and remain ill frequently. This may be another cause of apathy, reduced activity and delayed motor development thus reducing their interactions with the environment.

### *Carer's behaviour*

Another possible mechanism is that the children's apathy and lower activity levels may cause the caretakers to become less responsive and stimulating towards them and this would impair their development. A further mechanism could be that the smaller size of the children related to their age may cause the carers to treat them as younger children and this may also hinder the children's development. In this way the child becomes isolated from the environment and may become habituated to this situation even after recovery from the acute episode.

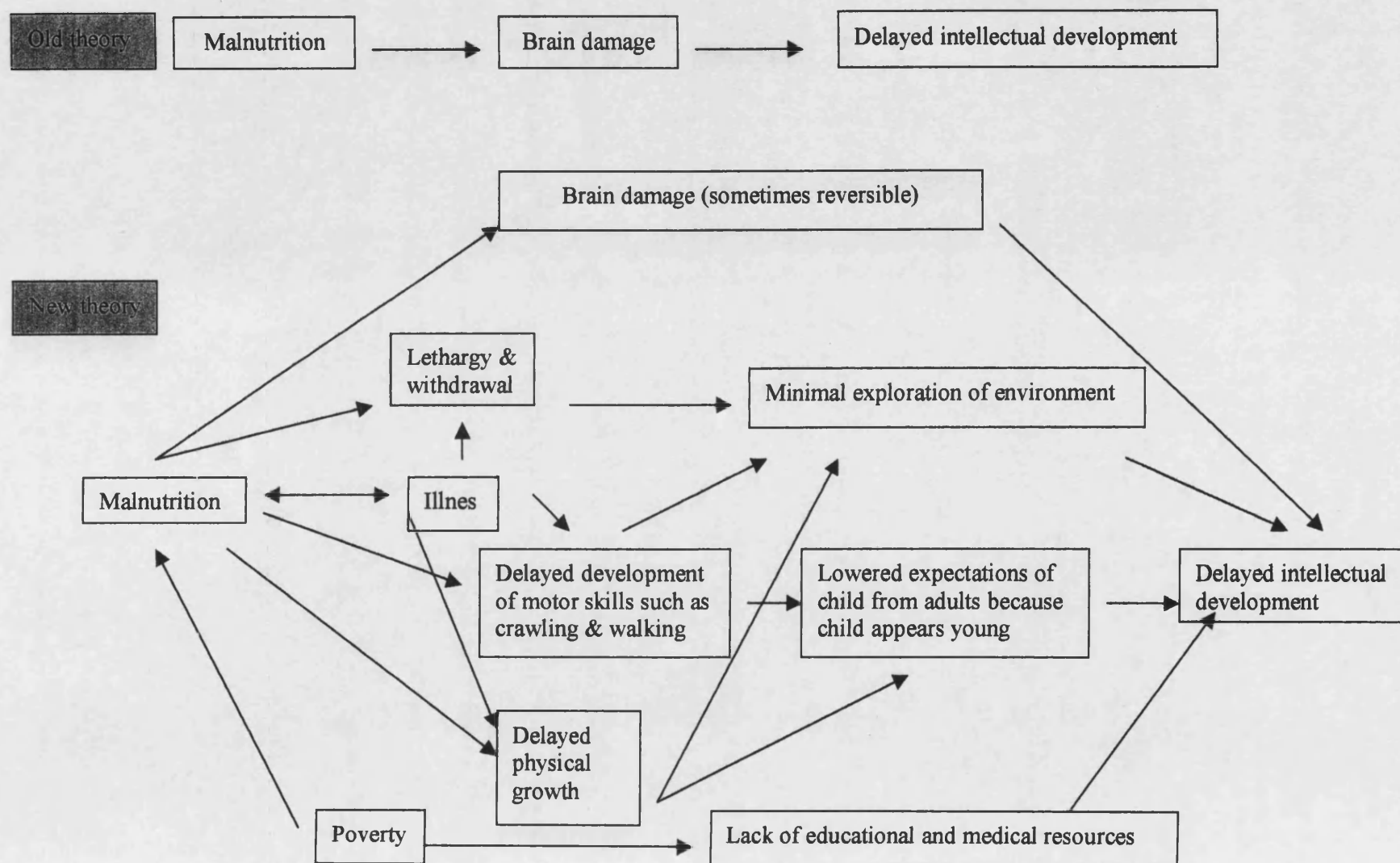
### *CNS changes*

Apart from these possible mechanisms, malnutrition may have a direct effect on the maturation of central nervous system and its function. Animal studies have

supported this hypothesis (Levitsky and Strupp 1995) and studies in malnourished children have shown that stunted children have smaller heads and head size in early childhood is a stronger predictor of IQ in later age (Grantham-McGregor et al. 1997) than concurrent anthropometric measures. Brown and Pollitt (1996) have demonstrated the possible mechanisms in the following diagram (Figure 1.7.1.).

It is likely that more than one mechanism is operating in each malnourished child and in addition, the severity of malnutrition, age of the child as well as the co-existence of other risk factors may all modify the effect.

Figure 1.7.1. Theories of how malnutrition hinders development from Brown and Pollitt 1996



## **1.8. JUSTIFICATION FOR THE PRESENT STUDY**

Considering the enormous number of malnourished children in Bangladesh and the high likelihood that their development is in jeopardy it is important that programmes to improve their development are initiated. I have not found any study in Bangladesh that looked at the effect of adding psychosocial stimulation to the treatment of malnourished children. Although there are a few preschool programmes (age 3 to 6 years) for children in general (PLAN Bangladesh 2002), there is little interest in psychosocial stimulation with younger children. I was unable to find any programme in Bangladesh with children under three years of age aimed at improving their development.

There are only a few early studies from other countries (mentioned in the above review of literature) that have evaluated the effect of adding stimulation to malnourished children's treatment. They were mainly based in hospital (Grantham-McGregor et al. 1980;1983;1987;Monckeberg 1979;McLaren et al. 1973) and all except the Jamaican one involved professional staff to do the intervention. The only community-based intervention of psychosocial stimulation with malnourished children was a second Jamaican study, which comprised weekly home visiting but included only moderately stunted children (Grantham-McGregor et al. 1991;Walker et al. 2000).

We planned to conduct an intervention with moderately and severely malnourished children based in community feeding centres in rural Bangladesh. We proposed using mothers' groups as well as home visiting with local village women as visitors. We are unaware of any previous study using this approach. It is therefore important to do a trial in Bangladesh where childhood malnutrition is a major public health problem in order to determine whether we can benefit the children's development with this approach in this culture.



## **CHAPTER 2**

### **HYPOTHESES, AIMS, OBJECTIVES**

#### **2.1. HYPOTHESES**

In Bangladeshi children we hypothesise that:

1. Adding child development activities to the treatment of malnourished children enrolled in CNCs of BINP will improve their mental and psychomotor development and behaviour.
2. The intervention will improve the mothers' knowledge of child rearing.
3. The malnourished children's mental and psychomotor development and behaviour will be poorer than that of adequately nourished children living in the same village and the malnourished children's deficit in development will be reduced after the intervention.

#### **2.2. AIMS**

The project concerns malnourished children in BINP nutrition centres. The aims are to establish a child development programme in the centres and determine the effect on the malnourished children's development and growth and their mothers' child rearing knowledge. A further aim is to compare the development of the malnourished children with that of adequately nourished children in the same village before and after intervention to determine the size of their initial deficit and whether they catch up to normal with intervention.

### **2.3. OBJECTIVES**

The specific objectives are:

1. To establish a child development intervention for moderately and severely malnourished children aged 6-24 months in CNCs using home visiting and mothers' groups.
2. In a randomised controlled trial, to determine the impact of the intervention on the following: child's growth in height and weight-for-height, developmental levels on the Bayley Scales, behaviour during the test session and mothers' knowledge of child development, health and hygiene.
3. To compare the developmental levels and behaviour of the intervened and non-intervened malnourished children with those of a group of adequately nourished children matched for age, sex and village of residence at the beginning and end of the intervention.
4. At the end of the study to train staff from the control feeding centres in the conduct of the programme.

## **CHAPTER 3**

### **METHODS**

#### **3.1. STUDY DESIGN**

The study was a randomised controlled trial of the effect of psychosocial stimulation on the development and growth of malnourished children. Cluster randomisation was used with 20 villages randomly assigned to treatment (psychosocial stimulation) or control. In addition a comparison group of adequately nourished children matched for village, age, and sex to the malnourished children was studied and their growth and development compared with the two malnourished groups. The purpose of testing adequately nourished children was to assess if they were different from the malnourished children at the beginning of the study and if the intervened malnourished children could catch up with the adequately nourished ones at the end of the intervention process.

#### **3.2. SITE SELECTION**

We selected BINP centres, which were close to Dhaka to facilitate accessibility. There are 3 sub-districts close to Dhaka named Narsingdi-Sadar, Shibpur and Monohardi. The centres in the first two sub-districts had already been functioning for a long time and had been used by other investigators for research purposes. Monohardi had recently started screening the children and was not used for any other research purpose. We therefore selected Monohardi for our study. Most of the population were extremely poor and lived on subsistence farming. Based on the latest available government report in 1981 Monohardi has a population of 243,650 with 47,332 households. It has a total area of 40,330 acres with 11 Unions (politically defined areas), 124 Mouza (sub-union) and 215 villages. The majority are Muslim (94.9%) but it also has a population of Hindu (5%) and very small number of Buddhists, Christians, Tribals and other religions. There are 127 primary schools, 40 high schools, 19 Madrasa (religious schools) and 2 colleges.

### 3.3. SAMPLE

#### 3.3.1. Sample size calculation

We calculated our sample size for the comparison of two means (Kirkwood 2001) based on the results of a previous study in Jamaica (Walker et al. 2000), which provided psychosocial stimulation to malnourished children and raised their developmental quotient (DQ) by 6 points with a SD of 12. We used a power of 90% and a significance level of 5%. A sample of 84 in each group was found to be sufficient to detect a difference of 6 DQ points between the groups with a power of 90% at 5% level of significance. Assuming a loss of 15% we increased the sample size to 100 children in each group. We used the following formula to calculate the sample size.

$$n > \frac{2(SD)^2}{(M_1 - M_2)^2} \times f$$

where, n= sample required

$\alpha$ = 5% level of significance

f= ( $\alpha\beta$ )=10.5

SD=Standard Deviation= 12

$\beta$ = 90% power

$M_1 - M_2$  = Difference = 6

$$n > \frac{2(12)^2}{(6)^2} \times 10.5$$

$$n > \frac{288}{36} \times 10.5$$

$$n > 84$$

Drop out = 15%

$$84 \times 15\% = 12.6$$

$$n = 84 + 12.6 = 96.6$$

### ***3.3.2. Sample selection***

The sample was selected in three stages; first the unions were selected, then the centres, and then the children.

#### **Selection of unions**

There are 11 unions in Monohardi. We first collected information on the accessibility of the unions. Out of the 11 unions, three (Gotasia, Charmandalia and Dolatpur) had 2 or fewer centres accessible by the usual transportations and were excluded.

We then ran a survey in all the remaining unions and collected the number of malnourished children who were attending the CNCs in each of the unions and selected accessible unions that had more than two centres in which more than 5 malnourished children were attending.

Three more unions, Lebutala, Sukundi and Khidirpur were excluded, as there were only 2 accessible centres with more than 5 children.

Five unions remained and each of them had the following number of centres with 5 or more children

1. Ekduaria	13 centres
2. Chalakchur	12 "
3. Baro Chapa	12 "
4. Chandan Bari	10 "
5. Kachikhata	9 "

#### **Selection of centres**

We numbered each centre and randomly picked 4 centres from each eligible union, making a total of 20 centres. We also randomly picked 2 extra centres from each union to replace any centre that may need to be dropped due to any unavoidable reasons.

We then, tossed a coin as to which two in each union would be the intervention and which the control. If by chance the two centres were so close that the staff or mothers could mix socially then we dropped the second one and picked another from the randomly selected extra centres.

### Selection of children

Two types of children were selected. Malnourished children were selected to take part in the randomised control trial of psychosocial stimulation and a group of matched adequately nourished children were selected as a reference group.

*Malnourished children* The malnourished children, who were referred to each CNC after the beginning of the study with weights-for-age z scores of  $< -2$  SD, aged between 6 and 24 months, and whose mothers consented to participate in the study and intended to stay in the area for one full year were eligible. All those who fulfilled the selection criteria were enrolled from each centre.

Exclusion criteria: Twins and disabled children were included in the intervention for ethical and demonstration purposes but were not part of the evaluated sample.

*Adequately nourished children* Alternate malnourished children in each centre were matched for gender and age ( $\pm$  six months) with adequately nourished children (weight-for-age  $\geq -2$  SD) living in the same village. Initially, our intention was to enrol adequately nourished children with a weight-for-age  $\geq -1.5$  SD but after screening the available children in the villages, we failed to find a sufficient number of adequately nourished children and therefore changed the selection criteria to weight-for-age  $\geq -2$  SD.

Exclusion criteria: Twins and disabled children were excluded.

The resulting three groups comprised of 101 intervened malnourished, 102 control malnourished and 107 adequately nourished children.

### **3.4. MEASUREMENTS**

The following measurements were assessed on each child:

#### *Developmental level*

The mental and psychomotor development of infants was assessed on the revised version of Bayley Scales of Infant Development (BSID-II) (Bayley 1993) at the beginning and end of the study. The test has two sub-scales that we used in the study, the Mental Development Index (MDI), and Psychomotor Development Index (PDI).

MDI includes items measuring cognitive, language and personal-social development. The cognitive items include memory, habituation, problem solving, early number concepts, generalization and classification.

PDI includes items of fine and gross motor development. Gross motor development involves mainly large muscle movements such as creeping, sitting, walking, running and jumping. Fine motor includes manipulations using fingers like grasping an object, putting pellets through a small hole and scribbling with a pencil (Bayley 1993).

The Bayley scales were originally developed in 1969 and have recently been revised and re-standardised (Bayley 1993). New items were added to cover recent research findings and include more valid and reliable measures of cognition such as habituation and novelty recognition.

BSID-II has been useful in a wide variety of clinical, educational, and research settings. It has been used as a diagnostic tool to identify developmentally delayed children, to record a child's progress after an intervention programme is started, to educate parents about their infants' development, and as a research tool to document differences between groups of children. This test covers a wide age range of 1-42 months (Bayley 1993).

The ability of Bayley scores in the first year of life to predict later IQ is poor but improves in the second year. McCall (1979) collated 20 studies assessing the predictive ability of infant assessments of future IQ scores. He found that the predictive ability was similar for all tests used including the Bayley. Tests given between 7 and 12 months had low to moderate correlations with IQ at 3 to 4 years

( $r=0.32$ ) and the correlations improved with age of initial testing to  $r = 0.50$  at 13 to 18 months and  $r= 0.59$  at 19 to 30 months. The predictive ability of later IQ at 8 to 18 years was lower being  $r = 0.25$  with initial testing at 7 to 12 months of age, and  $r= 0.32$  with testing at 13 to 18 months, and  $r=0.49$  with testing at 19 to 30 months. Tests of recognition memory and habituation in the first 6 months have higher predictive validity but after 12 months the difference is less (Colombo 1993). Following the revision of the Bayley scales more items of cognitive measurement such as habituation, recognition memory and problem solving have been added so as to improve the predictive ability of early testing. The BSID-II MDI scores at 36 to 42 months correlates moderately with scores on the McCarthy general cognitive index ( $n= 30$ ,  $r=0.79$ ) and with the Weschler Preschool and Primary Scale of Intelligence full scale ( $n=40$ ,  $r=0.73$ ) (Bayley 1993).

The BSID-II is well standardised for the population in the USA on a large representative sample. In the USA the Bayley has good test-re-test reliability over short periods and both the mental and motor scales have good internal reliability. The content validity (whether the items adequately represent the intended domains of development) was established by consultation with a panel of experts, who determined the domains that should be assessed and whether the items adequately measured them. The construct validity has been determined by correlations and factor analyses.

The Bayley therefore has good psychometric properties in the USA. However, when used in other cultures, where it has not been standardised, the validity and norms of the test become questionable.

The Bayley test has not been standardised for Bangladesh and there has been no study of validity here. However, we chose to use the Bayley test for several reasons. The test has been used in many developing countries, and has been the instrument of choice for much nutrition and child development research at this age in other countries like Indonesia (Idjradinata et al 1993) and Brazil (Grantham-McGregor et al. 1998). The Bayley has often been sensitive to changes following interventions (Husaini et al. 1991;Idjradinata et al. 1993;Pollitt et al. 2000). It is the only test we know of for this age group that has been used



here previously in research. In four recent studies the scores of urban and rural children were in the normal range and good inter-observer reliability and short term test-re-test stability were achieved (Hamadani et al. 2001;Hamadani et al. 2002;Tofail et al. 2002;Black et al. in press). Furthermore sensible and predictable correlations were found between the scores and socio-economic conditions, parents' education, stimulation in the home and children's nutritional status. These findings are encouraging but there remains a need for standardisation and validity studies.

Because the Bayley had not been standardised in Bangladesh we had no intention of comparing these children's scores with the test norms or children of other countries. Our aim was only to compare the development of groups of children within the same community. Furthermore, we are unaware of any other infant test that had been validated or standardised for Bangladesh.



Fig. 3.1. Test sessions of BSID assessing MDI (above) and PDI (below)

The assessments were done by one of three trained female testers. Care was taken to keep the testers blind to the child's group and the children were brought to a central office for testing. They were tested in a quiet room in presence of their mothers (Fig. 3.1.). Children who were sick on the day of test were treated and tested when they recovered. The tests were repeated on a randomly selected sub-sample of 80 children (25% from each of the 3 groups) approximately 8 months after enrolment to assess the progress of the intervention. Results are shown in chapter 7.8.

### *Behaviour*

We did not use the Behaviour Rating Scale (BRS) of BSID-II for this study because we found it difficult to get reliability between the testers on the large number of scores. Similar difficulties had previously been found in Brazil (Grantham-McGregor, personal communication). The children's behaviour during the tests was therefore rated on scales designed by Wolke (Wolke et al. 1990) for English children that were based to some extent on the Bayley. The ratings were designed to assess behaviour and mother-child interaction of one-year-old infants with failure to thrive and the authors found that the ratings were in agreement with children's developmental measures and parents' report of children's temperament. We used five of the scales, which have 9-point ratings and alternate points are carefully defined. Similar to the Bayley ratings, the child's typical behaviours throughout the test are rated.

The five scales that were used are described below:

The Approach scale is an exception to the other four scales in that the child's initial response to the examiner is rated for first 10 minutes only. At the beginning of the Bayley test the tester addresses a few introduction remarks to the child and gives the child a toy then talks with the mother. The Approach is rated at the end of the initial 10 minutes and ranges from avoiding=1 to friendly and inviting=9.

The four other ratings are rated at the end of the test. These include: infant's activity, emotional tone, cooperation with test procedure and vocalization. Emotional tone refers to the child's affect during the examination (unhappy and

crying for long periods=1, radiates happiness=9). Activity refers to how physically active the infant was during the testing (gross motor activity) (very still=1, overactive=9). Cooperation is a measure of how well the infant cooperates with the examiner and complies with her requests (resists all suggestions=1, always complies=9). Vocalization refers to non-crying utterances or to recognisable utterances embedded in crying. These may be cooing, babbling, consonant sounds or words (very quiet=1, constant vocalisation=9).

The details of the ratings are given in chapter 7.1. The ratings have previously been used in Bangladesh (Hamadani et al. 2001; Hamadani et al. 2002) and Brazil (Ashworth et al. 1998), where good inter-observer reliabilities were achieved. In Brazil they were sensitive to differences between low birth weight and normal birth weight babies (Grantham-McGregor et al. 1998) and in Bangladesh to the effects of zinc treatment.

### Training

A trained and experienced psychologist trained the testers to conduct Bayley test and behaviour ratings on children.

### Reliabilities

Short term test-retest reliabilities on the Bayley indices were assessed in a previous study in 1997 over a span of 7 days by the same research group and intraclass correlations of 0.94 for MDI and 0.98 for PDI were achieved (Hamadani et al. 2001). It was not therefore repeated in this study.

Inter-observer reliabilities between the trainer and the testers were assessed before the study. The reliabilities among the 3 testers, each testing 20 children before the study began were 0.99 for MDI and PDI and ranged between 0.95 and 0.98 for the behaviour ratings using average measures of intra class correlation. The testers observed 7% of each other's tests during the study and scored independently. The inter-observer reliabilities were calculated and  $r$  values were between 0.92 to 0.98 for all the ratings except for activity which was 0.79. After the baseline measurements were finished and before the final evaluation the testers were given

further training and inter-observer reliabilities obtained before and during the final tests and similar reliabilities were achieved.

### *Anthropometry*

All children had their weight, length, head circumference and mid upper arm circumference (MUAC) measured using standard techniques (Lohman et al. 1989) on enrolment and every 3 months by 2 trained research assistants. The mothers were also measured for their height, weight and MUAC at the beginning and end of the study. The testers were extensively trained by one of the co-investigators who has a PhD in nutrition until no more than 0.5 cm difference was observed on 20 consecutive measurements between the trainer and the testers as suggested by Frisancho (1990). Children's weight was measured using a digital scale, which was calibrated before each measurement, and therefore no intra or inter-observer reliability tests were conducted. Technical error of measurement (TEM), which is the square root of measurement error variance, is the most commonly used measure of anthropometric precision and accuracy. The testers carried out repeat measurements on 10 children and 10 adult women.

TEM for the testers was calculated using the guideline suggested by Ulijaszek (Ulijaszek and Kerr 1999).

Intra-observer TEM for two measurements by each of the testers and inter-observer TEM between the two testers were calculated using the following formula:

$TEM = \sqrt{(\sum D^2)/2N}$ , where D is the difference between measurements and N is the number of individuals that were measured. After finding TEM for the 1<sup>st</sup> (TEM (intra<sub>1</sub>)) and 2<sup>nd</sup> (TEM (intra<sub>2</sub>)) testers and the inter-observer TEM (TEM (inter)), Total TEM was calculated using the following formula:

$$\text{Total TEM} = \sqrt{((\text{TEM (intra}_1\text{)}^2 + \text{TEM (intra}_2\text{)}^2)/2 + \text{TEM (inter)}^2)}.$$

Total inter-subject variance (SD<sup>2</sup>) was then calculated in order to calculate the coefficient of reliability (R) using the following formula:

$$R = 1 - (\text{Total TEM}^2 / \text{SD}^2)$$

The results are shown below in the table 3.1.

**Table 3.1.**  
**Technical Error of Measurement for mothers' height and MUAC, and**  
**Children's length, MUAC and Head Circumference.**

	TEM (intra <sub>1</sub> )	TEM (intra <sub>2</sub> )	TEM (inter)	Total TEM	SD <sup>2</sup>	R
Mothers' height	0.11	0.12	0.12	0.01	25.87	0.998
Mothers' MUAC	0.08	0.11	0.07	0.08	5.3	0.985
Children's length	0.10	0.07	0.12	0.02	16.8	0.998
Children's MUAC	0.12	0.10	0.10	0.15	1.7	0.987
Children's head circumference	0.12	0.08	0.15	0.14	3.84	0.995

The inter-observer reliabilities between 2 testers of the anthropometric measurements were also assessed during the study on 30 cases (10%) at each period of measurement (0, 3, 6, 9, and 12 months in the study) and the intra class correlation coefficients were 0.98 for MUAC at 6 months measurement and 0.99 for all other measurements.

#### *Socio-economic background*

All homes were visited at the beginning of the study and information was sought on the families' wealth (furniture, valuables, animals and other assets owned by the family), standard of housing (structure of the roof and walls of the house, presence or absence of sanitary latrine, water and electricity in the house), family structure (number of family members, number of children in the family) and parental education and occupation. The questionnaire is included in the chapter 7.2.

#### *Stimulation in the home*

The stimulation in the home was assessed using a modified version of the Betty Caldwell's Home Observation for Measurement of Environment (HOME) (Caldwell 1967). The inventory was developed in 1965 for use in Head Start and was intended to describe the environment of the children and to be sensitive to change. Caldwell describes the instrument as follows:

*"The inventory was compiled after discussions with various Head Start planners about... 'the need for some type of instrument that would provide an indication of how much a disadvantaged child, prior to his introduction to Head Start, had achieved in areas regarded as necessary foundations for subsequent success in school.'"*

*Caldwell 1967*

We used the following subscales of HOME:

- Organisation of physical and temporal environment
- Stimulation
- Maternal involvement
- Play materials
- Punishment
- Emotional and verbal responsivity

Although the inventory was designed for the USA it has been used in many other countries. A recent meta-analysis of 12 psychosocial intervention studies showed that the HOME improved along with the children's development (Kendrick et al. 2000). And it has been suggested that improvements in the environment mediate the children's developmental benefits (Bradley et al. 1994).

The instrument was translated and piloted then modified for use in rural settings in Bangladesh. Most modifications were made to reduce the chances of getting a floor effect (i.e. all children scoring zero for certain items). For example the question: "at least 3 adult books or magazines are present at home" was changed to "at least one adult book or magazine is present at home". Questions that asked about the frequency of stimulation activities were open-ended and were recoded according to the frequency of their occurrence. The interviewers were trained on the use of the instrument and inter-observer reliabilities were assessed before and during the interviews. Unfortunately due to lack of human resources and political problems in the country we were unable to conduct the interviews on enrolment. The assessment was conducted between 3-6 months of the initiation of the study. The questionnaire is given in chapter 7.3.

### *Child rearing practices*

An instrument to assess mothers' knowledge of child development and child-rearing practices likely to promote good child development was developed based on the feed back from our focus group discussions and one used in Jamaica. It was then translated, piloted and field-tested. The instrument contained open-ended questions as well as pre-coded questions assessing mothers' knowledge pertaining to how children develop and the best ways to promote a child's optimal mental development. It also included questions to assess their knowledge of nutrition, health and hygiene, including breast feeding and weaning, immunisation, use of oral rehydration solution, use of iodised salt, and hand washing. Out of 17 questions for child rearing practices 10 were open-ended and were scored later. Responses were given a positive score for each answer mentioned by the mother that we judged to be appropriate for the child's age and likely to promote development. All answers to open questions were summed with the responses to the coded questions giving a total score of knowledge. The questions concerning child development were summed separately from those concerning nutrition, health and hygiene. The questionnaire was given at the beginning and end of the study by the trained interviewers who were blind to the groups and reliabilities were assessed before and during the interviews. The test-retest reliabilities on 13 cases before starting the tests were 0.50 for the mothers' knowledge of child rearing and 0.69 for their knowledge of health and hygiene. The low test-retest reliabilities were of concern to us but the questions were open-ended and perhaps if we had restricted the questionnaire to pre-coded questions it would have been more reliable. The questionnaire is given in chapter 7.4.

## **3.5. INTERVENTION**

### *3.5.1 Nutritional supplementation*

The BINP programme in the study area was conducted by a non-governmental organisation on behalf of the Bangladesh Government. The programme included daily visits by the mothers and their malnourished children who were enrolled in the CNCs for 6 day a week and it continued for a minimum of 90 days on which the children received a food packet. The day on which the child did not attend was not counted in the 90 days; therefore, a child could have remained enrolled in the

programme and continued to attend a centre for more than 3 months depending how often s/he attended. If a child remained severely malnourished after 90 days of nutritional supplementation then supplementation was continued for another 30 days and if after a total of 120 days the child still remained malnourished they were referred to a nearby health centre. The food packets contained roasted rice and lentil powders, molasses and soy oil. The contents of the packets were mixed with a small amount of water to make it palatable before consumption. The compliance of the supplement measured in pregnant women attending the programme in four other unions was found to be low (Shaheen et al. 2000) however we could not find any study that assessed compliance in children attending the study centres. Each packet contained 150 kcal and the children with moderate and severe PEM were supplied with one and two packets respectively.

### *3.5.2. Psychosocial stimulation:*

#### 3.5.2.1. Focus Group Discussions

As a first step in designing the intervention we planned to hold focus group discussions (FGDs), in order to have an understanding of local child rearing practices. Qualitative research methods are valuable in providing understanding about local beliefs, ideas, practices, and behaviours and FGDs are found to have many advantages for assessing the above. FGDs are relatively quick, and more sensible than the structured questionnaires to assess respondents' ideas, when there is very little existing knowledge available. There is a possibility that FGDs may have an inhibiting effect on those who are shyer than others and that they may not express themselves freely in front of others. However, it has been shown that usually the less inhibited members of the group are able to break the ice and provide mutual support to those who are shyer often leading them to make statements that they usually would not have made in public (Kitzinger 1995). But, there is always a risk that dominant personalities may exert undue influence and participants are unlikely to be representative of the population. It is therefore important to have well trained moderators.

The research question was “to determine the existing child rearing practices of rural Bangladeshi mothers and the feasibility of starting such a programme for rural children and their mothers”. Colleagues who had experience and training in



qualitative research helped us train our staff. We then followed the procedure outlined in the Dawson and Manderson manual (1993) prepared for people with no formal training in qualitative research. As the method of conducting the interviews and the role of the moderator were of prime importance (Britten 1995) we made sure that the staff that were going to be moderators, note takers and transcribers were thoroughly trained in this process. After extensive piloting, we conducted 7 focus groups with 51 mothers attending nutrition centres that were not part of the main study. We also conducted 7 more FGDs with 50 mothers of adequately nourished children in the same villages. The FGDs were conducted approximately 8 months before the enrolment of the subjects.

In these focus groups, the following points were the research questions and with the help of a questionnaire (given in the chapter 7.5) these were discussed with mothers to assess their knowledge, attitude and practice:

1. How does a child's language, motor and cognitive development occur? What prevents good development? What are causes of delay and how to correct such delays?
2. Role of parents and family members in facilitating development of children.
3. Role of play in development of children, types of games that parents and other adults play with the children.
4. Gender differences in child rearing practices.
5. Specific role of father in child rearing.
6. Routine care practices performed by mothers with special emphasis on feeding.
7. How they discipline a child, need for punishment.
8. Their views of an ideal child.
9. Their access to resources of the family, who makes the decisions regarding child rearing.
10. Is such a programme of psychosocial stimulation necessary for children? Could mothers attend it? Would they face any problem in attending the programme?

### Results of focus group discussion meetings

Based on Creswell's recommendation a narrative form is used to discuss the results of the FGDs (Creswell 1998). Below is a preliminary analysis of the FGDs. Quotes from these FGDs are presented in chapter 7.6.

- **How children develop? What promotes good development?**

There was little mention of play (toys, books). Most mothers talked about the importance of nutrition and that of education. Some believed they could not do anything to improve children's development and that development was an innate quality and improved with age.

- **Mothers' perception of the causes of delay in language and motor milestones and how to deal with them**

These were mostly concerned with nutritional deficiency. Some mothers mentioned the role of evil spirits and said they sought remedies from traditional healers and few mentioned that their reliance was totally on God and that they couldn't do anything.

- **Role of father**

Most mothers felt strongly that fathers had an important role in the child's education and upbringing and in playing with the child. They mentioned father's role in teaching names of various people and objects to the child, in showing love and affection and in providing the basic life's needs for the child

- **Role of other family members**

Since most of the families live as extended families a lot was mentioned about the role of grandparents, aunts and uncles. Mention was made of their role in helping with physical care of the child, showing love and affection, encouraging them to go to school, teaching religious themes, playing with the child, taking him/her around, and showing objects to the child.

- **Role of play**

Mothers mentioned the importance of play in keeping the child healthy and giving physical strength to the child. Most of them thought that play was needed to make the child happy and a few said that playing helped the child learn and improve his/her intelligence.

- **Gender differences in play, work, and opportunities**

Almost all the mothers believed that girls should do house work and boys should be allowed to play more than girls.

- **Punishment/reward**

It was a common idea that the child must be punished. Physical punishment was fairly common but scaring the child and threatening were more frequent. Giving rewards for a good behaviour like kissing and giving some cookies or chocolates was rarely mentioned.

- **Care practices**

Mothers were asked about their feeding and bedtime practices and how much they were spending time with their children, playing with them and responding to their needs.

- *Feeding practices*

Some mothers mentioned use of force-feeding occasionally. Some however did mention that they told the child something interesting while trying to feed him/her and a few said they showed objects and labelled them for the child while feeding. Few mothers mentioned intimidating talks and frightening the baby at the time of feeding.

- *Bedtime practices*

Some mothers said they told stories or sang to the child while putting her to bed and most of the mothers kept the baby close to

them at the time of sleeping and patted on their backs till they fell asleep.

➤ *Playing and attending to the child's needs*

Some mothers said they played with the child in their leisure time and a few said they made home-made toys for the child to play with. If they were busy they rarely paid attention to the child and even mentioned physical punishment if the child bothered them while they were working. A few however said they managed to get the child to happily leave them alone while they were working and that they attended to the child's needs later when they were free.

- **An ideal child**

Most mothers defined an ideal child as one who is very obedient to parents, well behaved, and one who is respectful to adults. A few mentioned a studious child as one whereas others didn't agree with that. A few also mentioned a religious child to be the ideal child.

- **Access to resources**

Some mothers had their own family farm through which they earned and could pay for some of the necessary expenses and therefore had some autonomy in expenditure. Some others had to wait for the fathers to come home and make important decisions even regarding feeding the child or taking the sick child for treatment.

- **The need for a programme of child development, problems and willingness to attend:**

Mothers were asked if they wanted to have such a programme in their village and all of them mentioned it was necessary and they were willing to attend it. However most of them thought they should obtain permission from their husbands and mother in laws otherwise they may object in their spending time in such a programme.

### Conclusions from the FGDs

There was little understanding of how children develop and how to promote good development. We therefore included an introduction on early childhood development activities in the first group meeting. The other finding was that punishment was fairly common and we planned to hold special sessions on the topic of avoiding physical and verbal punishment. Mothers paid very little attention to playing and chatting with the child and generally failed to recognise the importance of play for child development. We therefore stressed the role of play in child development in the curriculum. Gender differences were quite obvious and the issue had to be addressed. We also realised that fathers and other family members especially mothers in law were very important and that they needed to be included in the programme. Therefore we attempted to include fathers and other family members who were present in the house whenever group meetings or home visits were conducted. Some fathers and mothers in law attended the visits and group meetings but unfortunately we did not keep a record of their attendance.

#### 3.5.2.2. Curriculum development

The curriculum for the home visits was based on one previously used in Jamaica (McDonald et al. 1989). It was modified for Bangladesh in the light of FGD results discussed above. We also included traditional indigenous games and songs whenever possible. For example there are several songs, which mothers sing and act to show different things to the child or get the child to join in the activities. The curriculum covered developmental ages between 5-36 months. The overall aims of the curriculum were:

1. To help mothers promote optimal development in their children including language, cognitive, social and emotional development.
2. To improve mothers' understanding of child development and their child rearing practices.
3. To encourage mothers to provide a loving, responsive and stimulating environment for their young child.
4. To help mothers improve their self-confidence in their parenting skills.

5. To improve maternal-child interaction so that mothers learn how to interact with their children in a way to improve his/her cognitive and emotional development.
6. To design a sustainable, low cost, culturally appropriate training package for use with parents of malnourished children who are at risk of poor development.

### General approach

Play Leaders (PLs) were appointed and trained to conduct the stimulation programme. Care was taken for the PLs not to lead the group sessions or visits in an authoritarian manner but rather to have a friendly relationship with the mothers. In the group meetings the aim was to have everyone including the PL exchanging ideas with each other. Role-play and demonstrations of specific activities were used as teaching techniques.

In order to help mothers improve their self-confidence in their parenting skills, the PLs were encouraged to listen to the mothers and seek their opinion on topics. They focussed on what parents already did which was helpful to their children's development. The mothers were appreciated for their existing skills and were praised for what they knew and did.

Emphasis was placed on using everyday activities for teaching purposes. Activities mothers could do with children at bath time, mealtimes, while getting dressed, going for a walk, performing household chores etc were developed.

Mothers were taught the importance of showing love and affection to their children and how this affected children's development. They were also shown with examples how to make a stimulating environment.

To improve maternal-child interaction, mothers were shown how to respond to the child's needs, respond vocally to their vocalisations, label the environment and generally chat with their child while doing house work or looking after the child. They were encouraged to show affection and praise the child's actions. Mothers were shown how to pay attention to the child and seize different occasions to chat and caress the child.

To design a sustainable, low cost, culturally appropriate training package for use with parents of malnourished children, low cost play materials made from available waste materials were provided. The parents were shown how to make simple playthings for their children. They were also encouraged to discuss other ways in which the toys and other household objects could be used to play with young children. Parents were asked to come up with ideas as to how to make homemade toys and those appropriate were added to the curriculum. In addition six low cost picture books, which were appropriate for use by illiterate mothers, were designed and published locally and were used in the intervention.

Before starting the programme some preliminary toys were made with the help of the existing staff in the project. The curriculum was then translated, piloted and field-tested to ensure its applicability to rural families. Modifications were made if any item was found unsuitable for the intervention for example fingers were used in a poem to demonstrate a story but it was found to be unacceptable in terms of the religious norms of the country and was therefore excluded from the curriculum. Toys for which waste materials could not be found easily were also excluded. Care was taken to make toys that were safe for children, durable, and easy to make.

#### 3.5.2.3. Intervention procedure

The intervention comprised group meetings and home visits.

##### *Group meetings*

Mothers met in groups at the CNCs for one hour once a week for 10 months then fortnightly for 2 months. Those who did not attend were visited at home and encouraged to come. The PLs discussed several developmental issues with mothers in a participatory manner. The topics discussed were modified from a curriculum prepared by Baker (Baker H. 1997, Personal communication) for use in a similar study in Jamaica. The curriculum included the main messages in 'The Programme for the Enrichment of Interactions between Mothers and Children' (WHO 1995) but with additional ones. It included an introduction to the programme, describing how children develop and the importance of play for development. Mothers were also taught the importance of praising the child and

giving positive feedback, chatting with the child, showing affection to the child, being responsive to the child's needs, providing opportunities for the child to play and explore, and make learning fun. The following are the list of the 14 topics discussed with the mothers in the group sessions:

1. Introduction to the programme and importance of early child development activities
2. The need for play
3. It is important that we show children we love them
4. Remember to praise the children
5. Helping our child learn
6. Communicating with your child
7. Making mealtimes a special time
8. Singing with your child
9. Things to do at bath-time
10. Getting your child's attention
11. Things to do when getting dressed
12. Learning to trust your family and friends
13. Children's feelings are very strong and they need to learn to understand and control these feelings
14. How to manage our children's behaviour

The detail of the topics covered in the group meetings is given in chapter 7.7.



Fig. 3.2. Group session with mothers and children in a Community Nutrition Centre.



At the meetings the mothers were helped to make home made toys, shown how to interact with their children in ways which were likely to encourage their development. In addition to developmental messages, health, hygiene and nutrition messages were also given.

#### *Home visits*

The PLs also visited mothers and children twice weekly for 8 months and once a week for the final 4 months at their homes. Each visit lasted almost an hour. The psychologists initially assessed the children's developmental level and then the toys and activities that were appropriate for their developmental age were chosen according to the curriculum. The PL carried toys and left them with mother and exchanged them on the following visit with new toys.

At these sessions the PLs played with the child and demonstrated to the mothers how to play with the child. As the mother developed an understanding of the toys and how to play with her child, the responsibility was handed over to her. Care was taken to appreciate mother for her activities and positive reinforcement was strongly encouraged. The PLs were also encouraged to always smile and keep a happy atmosphere for the mothers and the children. The developmental activities were conducted in a playful manner and not as a work-oriented activity.

At each visit specified play activities were demonstrated. The curriculum contained a detailed description of the play and the constructs to be taught. At each visit a song, a new toy and a language activity were taught. The songs chosen for the younger children were easy 1-2 line songs while for older children longer songs were taught. The toys included plastic rattles, shakers, ball and dolls for the younger aged children. These were made more advanced for the older ones and toys like mazes, matching sizes, colours, shapes, etc. and pretend games were taught to children over 2 years of age. Children who were sick at the time of the visit were not given the new curriculum but were taken to the local office and examined by a paediatrician and treatment was offered to them.



Fig. 3.3. Home-made toys, books and other materials used in the curriculum.

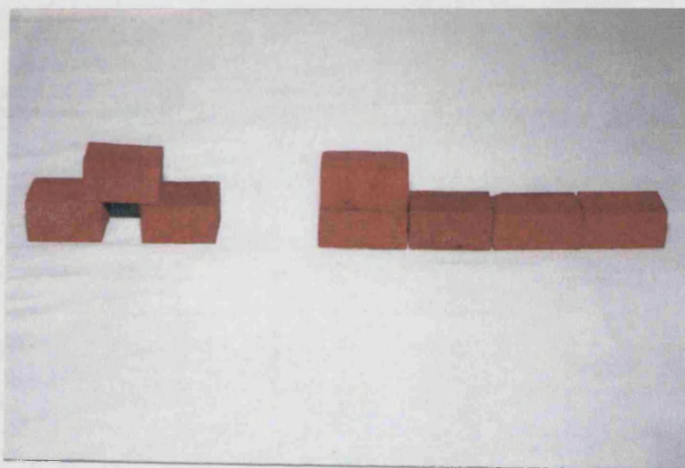


Fig. 3.4. Wooden blocks used for psychosocial stimulation of the children.

#### 3.5.2.4. Recruitment of local staff

##### *Play Leaders*

In the intervention centres, ladies with a maximum of 10 years of schooling and living in the same villages were interviewed. One lady was chosen from each village. Suitable ones who were found to have initiative and be willing to work dedicatedly were selected. They were called play leaders (PL) and each worked in the CNC where she lived. They organised all the activities with the mothers and the children. Out of the ten PLs, 5 were married and two had children.

Before the study began the PLs were trained extensively on how to visit the houses, demonstrate play techniques and how to run playgroups for two weeks.

They also helped in making the toys. Training was ongoing and every week the PLs met with the investigators and any problems were discussed and solved. In addition there were one full day of training every month.

Their initial task was to identify the children both malnourished and well nourished for the study. After baseline measurements had been taken, they then started the intervention.



Fig. 3.5. A mother is naming pictures for her child during a home visit while the play leader is looking on.

#### *Health Workers*

In the control centres, one Health Worker (HW) with 10-12 years of schooling was recruited for every two villages. We therefore had 5 HWs for the 10 control villages. They assisted in identifying the sample. They kept track of the children and encouraged their attendance in the CNCs and consumption of the supplement packets by visiting the CNCs and asking the person in charge about the children.

#### *Office assistant*

Communication was difficult as there were no telephones in the villages, we therefore recruited one male office assistant with 12 years of schooling who helped the investigators in finding the homes of the children and conveyed messages to and from the PLs, HWs and supervisors.

### *Supervisors*

We recruited 3 supervisors and each supervisor was responsible for 3 or 4 PLs and 1-2 HWs. One of them, however, left in the middle of the study and her job was shared by the other two supervisors. The villages were some distance from each other and communication was difficult, therefore, much time was taken by the supervisors to go from one village to another. The PLs were given report forms, which they filled-in every time they visited the homes of the children. The supervisors met with each PL once a week when each report form was checked. On the basis of their reports, the supervisors decided if the children were at the appropriate level on the curriculum or whether they should be moved to an easier or more difficult level the following week. All children were also visited by one of the supervisors once every two months and assessment of whether they were at the right level of difficulty on the curriculum was again made. The PL was also assessed and rated on the quality of the visit. The supervisors also observed one group meeting a month for each PL in which the strengths of the PL were reinforced and any problem was discussed with her. The supervisors met with the principal investigator (myself) once a week and discussed the progress of the children as well as performance of the PLs. On a regular basis we visited the PLs while they were performing their tasks along with the supervisors and assessed their performance in the field.

Summary of all the staff working in the project, their duties and qualifications are given in the Table 3.2.

### **Role of the candidate in the study:**

The candidate wrote the proposal for the study that was then reviewed externally. She responded to the reviewers' comments and then successfully defended the protocol in the Research and Ethical Review Committees at ICDDR,B as a requisite for starting any project. She contacted the BINP and CARE authorities to seek permission to conduct the study in the CNCs. She had to compete for the funding of the project with other employees at her organisation and was successful in availing the fund. She prepared the new instruments that were not previously used by the research group, i.e. the questionnaires for the FGDs and assessing mothers' child rearing practices. She also modified the HOME scale and

**Table 3.2.**  
**Summary of staff working in the project**

<b>Staff (n)</b>	<b>Duties</b>	<b>Qualification</b>
Play Leader (10)	One play leader worked in the each of the intervention villages to identify, trace and bring children for the initial and final tests and to conduct the visits of psychosocial stimulation with the children and teach their mothers on the curriculum. They also made the toys and helped in collecting the waste materials for the toys.	Class 10
Health Worker (5)	Each one worked in two of the control villages to identify, trace and bring children for the initial and final tests	Class 10 -12
Office assistant (1)	To assist in maintaining the communication between the villages, contacting PLs and HWs and help in locating children whenever necessary	Class 12
Cook (1)	To cook food for the staff when they stayed at the field in Monohardi (4-5 days a week)	Class 5
Field Research Assistant (2)	To interview mothers in their homes on maternal knowledge on child rearing and to assess psychosocial stimulation at HOME. They also collected information on SES.	Bachelor degree
Supervisor (3)	To train and supervise the work of the Play Leaders and rate their performance on regular visits	Bachelor degree
Testers (3)	To perform Bayley tests, observe behaviour of the children and perform anthropometric measurements of mothers and children every 3 months	Masters degree

all the scales were translated, field-tested and piloted in rural areas by the candidate. She also modified the age-specific curriculum for psychosocial stimulation of children based on the one used in Jamaica and from the experience gained by conducting FGDs, translated and field-tested it.

She then selected and trained the staff who worked in the project on the following measures:

- Conducting FGDs
- Bayley test
- Behaviour observation
- Interviewing mothers for their child rearing practices
- Interviewing mothers for HOME
- Anthropometry
- Psychosocial stimulation

The candidate visited the research areas regularly and made at least one visit to each of the 10 intervention villages once every fortnight. She had weekly meetings with the PLs and their supervisors who showed her the children's progress and on which she instructed them how to follow the curriculum in case a child was not developing as expected.

Apart from direct supervision of the project she had to manage the budget and make regular financial report to the finance office at ICDDR,B and technical progress report to World Bank and DfID that had funded the project as well as to ICDDR,B.

#### **3.5.2.5. Procedure**

Identified children had baseline measurements of development, behaviour, and anthropometry. Their mothers were also given a questionnaire concerning their knowledge of child rearing and health and hygiene at enrolment and their homes were visited to assess psychosocial stimulation at home 3-6 months after the initial measurement.

The intervention ran for 12 months including home visits and group meetings.

The children's development, behaviour, anthropometry and their mothers' knowledge were reassessed at the end of 12 months +/- 15 days.

The control malnourished and the adequately nourished groups also had the same measurements at the end of the study.

*Midterm evaluation:*

As it was the first time that such type of intervention had been carried out in Bangladesh we decided to get some idea of progress of the children approximately mid-way through the study. We would also get some idea of the timing of any change in development. Therefore approximately 8 months after the initiation of the study, we randomly selected a sub-sample of 25% children (n=80) from each of the 3 groups. They were examined for their development and behaviour ratings to assess the progress of the study. These results are presented in chapter 7.8.

*Training of staff in control villages:*

At the end of the study once all the children were retested, the staff working in the control villages were trained in providing psychosocial stimulation to malnourished children. They were supplied with a set of curriculum booklet and few toys that were being used for the study children. They were asked to have sessions with mothers of malnourished children in their villages telling them how they could improve their children's development. They were also asked to visit the homes of the children and to show mothers and their children how to play with the toys in a developmentally appropriate way. Since the study was not funded beyond the final tests, we have not been able to evaluate how far they followed our advice and if the children in the control villages made any improvement.

### **3.6. ANALYSIS**

The data were entered in a personal computer using the SPSS-PC version 10 and were entered twice to check for any wrong entry. The outliers were then checked and any suspicion of an error was rechecked and corrected if found.

*Socio-economic Indices*

In order to reduce the data, the socio-economic variables were recoded or scored and added to make indices according to theoretical considerations as follows:



Housing Index was calculated on the basis of the condition of the roof and wall of the house and presence or absence of electricity in the house. Roof was scored as '0' if it was made up of straw and '1' if it was tin or cement. Similarly wall was scored as '0' if it was made with straw, jute, bamboo or was earthen and '1' if it was tin or cement. Presence of electricity was scored as '1' and its absence as '0'. The 3 variables resulted in a scoring of 0-3.

Sanitation index included type of the latrine and availability of water inside or outside of the house. Water available within the house was scored as '1' and outside was scored as '0'. Open latrines were scored '0' and the sanitary and semi sanitary ones as '1'. These 2 variables resulted in a scoring of 0-2.

Household possessions were added up together and produced an Asset index. Possession of a rickshaw or van was scored as '2' and '3' respectively while having a radio, television, cassette player, watch or clock, bed, chair, table, cabinet, fan, bicycle and any other electric goods were each scored as '1'. The absence of any of the above was scored as '0'. The total scores were between 0-16 for the asset index.

Animals owned by the family were also scored according to the approximate market values of each animal and then added to make an animal index. Possession of cows/buffaloes was scored '4', goats as '2' while chickens or pigeons as '0.1'. The total scores varied between '0' and '104'.

Crowding index was calculated by dividing the number of people in the house by the number of rooms.

Based on the interviews with mothers at the beginning and end of the study indices of "mothers' knowledge of child rearing" and "mothers' knowledge of health and hygiene" were calculated by adding up the scores that each mother gained by answering the questions correctly.



### *Transformations*

Frequency distribution of the variables and normality were checked. Transformations were used to normalise the variables when necessary. Crowding index was both skewed and kurtosed and therefore a log-10 of the variable was used to normalise the data. Animal ownership was also skewed and kurtosed and it was due to a single family who owned many chickens and therefore the variable was recoded on the basis of having scores of '0', between '0.1-1.0', '1.1-5.0' and '>5'.

Parents' education was reported as the years of schooling. It was then recoded into a dichotomous variable of schooling < 5 years or  $\geq 5$  years.

The weight and height of the children was entered into EpiNut using Epi-info 6 and were converted into z scores according to the NCHS median (U.S. Food and Nutrition Board 1974).

### *Relationships among variables*

The correlations between the developmental scores, and age and sex were calculated.

As age of the children at the time of testing was correlated with MDI, activity and vocalisation ratings in both the malnourished groups and with approach and emotional tone ratings in the well-nourished group; the relationship between the developmental variables and socio-economic and child variables were examined controlling for age if the developmental variable was significantly related to age.

### *Difference between the lost and tested children*

We conducted chi-square test for the dichotomous variables and independent sample t-test for the continuous variables to see if there was any difference between the children who were lost and those who were tested at the end of the study.

### *Multiple regression analyses*

In order to examine differences in development and behaviour on enrolment between malnourished and adequately nourished children taking into account socio-economic variables multiple regression analyses were conducted. Age was first entered then all variables which were significantly correlated with the outcome variables were offered and finally in a third step nutritional group (all malnourished children =1, adequately nourished children =2) was entered.

### *Analyses by intention to treat*

The effect of the intervention was examined in multiple regression analyses of all the developmental and nutritional status outcomes with the malnourished groups only. In the model to predict the final outcome variable, age and the relevant initial measurement were entered in the first block. Fathers' education, which was significantly different between the malnourished groups, was offered in the second block. Then treatment (treatment=1, control=2) was entered in the third block.

### *Interactions*

Interaction between treatment and other correlated variables were calculated and examined in the regression models.

### *Analyses comparing malnourished groups with adequately nourished group in change in outcome variables*

In order to examine whether the malnourished groups caught up with the adequately nourished group over the study period a further set of multiple regression analyses were conducted. In the model to predict the final developmental and behavioural variables, age and the relevant baseline variable were entered in the first block. Mothers' education and knowledge of health and hygiene, which were significantly different on enrolment between the malnourished groups combined and the adequately nourished group, were offered in the second block. Two dummy variables to control for the differences of the adequately nourished group with intervened and control malnourished groups were computed and entered in the third block.

### *Multilevel modelling*

Since randomisation was conducted at the level of the CNCs and the children were clustered in villages, we reran all the analyses controlling for among villages variance by using multilevel modelling regression analyses with the malnourished children only. For this analysis, we used the computer package designed by Goldstein for the Institute of Education, London (Goldstein et al. 1998).

### **3.7. ETHICS**

Permission to conduct the study was obtained from the BINP headquarters as well as CARE that were operating the centres. The Research and Ethical Review Committees at ICDDR,B approved the protocol. Written consent was obtained from the parents at the time of enrolment of the children.

## **CHAPTER 4**

### **RESULTS**

I will present the results in the following order:

First I will present the details of any loss of children from the sample (4.1). Then I will compare the characteristics of the combined malnourished groups with those of the adequately nourished group on enrolment to assess whether the malnourished children began with any disadvantage (4.2). Then I will compare the intervened and control malnourished groups on enrolment to determine if the groups were similar at the beginning of the trial (4.2). Following this I will present the effect of the psychosocial stimulation treatment on the malnourished groups (4.3). I will then compare the intervened and control malnourished groups with the adequately nourished group at the end of the intervention to determine whether any deficit in the malnourished groups development remains (4.4). Finally I will examine the relationship between the quality of intervention and the response in growth and development (4.5).

#### **4.1. LOSS FROM THE SAMPLE AT THE END OF STUDY**

A total of 313 children were selected for the study. Three children were excluded; one was found to have previously undiagnosed congenital heart disease, the other one suffered from a systemic disease that could not be diagnosed and both were referred to a tertiary paediatric hospital for treatment. The third child was extremely irritable during the tests and it was not possible to complete the developmental tests. All three were from the intervention group.

Out of the 310 children who were tested initially, 11 were lost (3.5%). Three children died; all from the intervention group. One died quite early in the study due to hydrocephalous as a consequence of meningitis. The other one died unexpectedly, midway in the study but the cause of death could not be ascertained by verbal autopsy. The third child was severely malnourished and had not improved, in spite of all efforts. He died just before he was about to participate in the final tests. Two children moved to Dhaka and could not be followed up both of them were in the intervention group. Three others, one in each of the intervention, control and comparison groups were sick at the time of the final tests and did not recover before the study was concluded. Three others; all from the intervention group, came from very fundamentalist Muslim families and didn't like outsiders entering their house. They refused to continue participating in the study, even though they had consented at the beginning.

##### **Differences between lost and tested children**

Out of the 11 lost cases, 9 children were from the intervention group and the other 2 were from the control and adequately nourished groups. We therefore, only looked at the differences between the lost and found children belonging to the intervention group. There were no significant differences observed between the lost and tested children.

## **4.2. COMPARISON OF THE MALNOURISHED AND ADEQUATELY NOURISHED CHILDREN ON ENROLMENT**

### *Sample description*

In order to determine whether the malnourished groups began the study with any initial disadvantage, the two malnourished groups were combined and their characteristics compared with those of the adequately nourished group. The results of the child characteristics are given in tables 4.1.- 4.2. and of the parents and home backgrounds in Table 4.3-4.6. As expected, the malnourished children were significantly smaller in all the anthropometric measures but did not differ from the adequately nourished children in age and gender (for which they were matched) (Table 4.1.).

The adequately nourished group had significantly higher MDIs and PDIs ( $p=0.04$ , and  $<0.001$  respectively) than the malnourished children. The difference between the groups was greater in PDI. There were no significant differences in the behaviour ratings (Table 4.2.).

The parents of the malnourished children had significantly poorer education and paternal occupation, and their mothers had poorer nutritional status and knowledge of parenting and health (Table 4.3.).

**Table 4.1.**

**Characteristics of children in the malnourished group (intervention and control groups combined) and the adequately nourished group on enrolment**

Variables	Malnourished Mean (SD) n=203	Adequately nourished Mean (SD) n=107	P value <sup>a</sup>
Age at enrolment (months)	14.7 (4.4)	14.3 (5.3)	0.5
Sex (boys %)	47	46	0.5 <sup>b</sup>
MUAC (cm)	12.7 (0.9)	14.2 (1.0)	<0.001
Head Circumference (cm)	43.7 (1.7)	44.7 (1.7)	<0.001
BMI (Kg/m <sup>2</sup> )	14.8 (1.1)	16.8 (1.3)	<0.001
HAZ score	-2.6 (1.1)	-1.3 (0.9)	<0.001
WAZ score	-2.8 (0.7)	-1.0 (0.7)	<0.001
WHZ score	-1.5 (0.7)	-0.19 (0.8)	<0.001

a=Independent sample t-test was conducted for all measurements except for (b) where Chi-square test was conducted.

BMI: body mass index (Kg/m<sup>2</sup>) MUAC: mid-upper arm circumference, WHZ: weight-for-height z score WAZ: weight-for-age z score, HAZ: height-for-age z score

**Table 4.2.**

**Developmental outcomes in the malnourished group (intervention and control groups combined) and the adequately nourished group on enrolment**

Variables	Malnourished Mean (SD) n=203	Adequately nourished Mean (SD) n=107	P value <sup>a</sup>
MDI	89.3 (15.3)	92.9 (13.5)	0.04
PDI	84.5 (17.4)	94.9 (12.9)	<0.001
Approach	6.2 (1.3)	6.3 (1.4)	0.4
Emotional tone	5.5 (1.6)	5.7 (1.3)	0.2
Activity	4.7 (1.1)	4.6 (1.2)	0.9
Cooperation	5.7 (1.6)	5.9 (1.4)	0.4
Vocalisation	3.8 (1.7)	4.1 (2.1)	0.2

a=Independent sample t-test

**Table 4.3.**

**Characteristics of parents in the malnourished group (intervention and control groups combined) and the adequately nourished group on enrolment**

Variables	Malnourished Mean (SD) n=203	Adequately nourished Mean (SD) n=107	P value <sup>a</sup>
Mother's BMI (Kg/m <sup>2</sup> )	18.1 (1.8)	18.6 (1.9)	0.02
Mothers' MUAC (cm)	21.6 (1.8)	22.3 (1.8)	0.002
Mother's education (% <5yrs of schooling)	54	37	0.003 <sup>b</sup>
Father's education (% <5 yrs of schooling)	56	41	0.008 <sup>b</sup>
Father's occupation (% Very poor)	69	49	0.001 <sup>b</sup>
Score of mother's parenting knowledge	15.3 (3.5)	16.8 (3.4)	<0.001
Score of mother's Health knowledge	5.7 (2.7)	6.8 (2.6)	<0.001

a=Independent sample t-test was conducted for all measurements except for (b) where Chi-square test was conducted.

Table 4.4. shows the details of the home backgrounds and the adequately nourished children were better in nearly all variables.

Some of the variables were combined to make indices (described in methods), which were used in the analyses and these are shown in (Table 4.5.). The malnourished group was significantly worse in all except animal index and crowding.

Table 4.6 shows the comparison between the groups in home stimulation, which was assessed between 3-6 months after the beginning of the study. The children's age at the time of home visits ranged between 8.1 to 29.34 months. The Mean age was 18.6 months and SD was 4.9. The difference between the malnourished and adequately nourished children was significant in the organisation of physical and temporal environment (p=0.02), stimulation (p<0.001), maternal involvement (p=0.01) and total scores (p=0.001) favouring the adequately nourished children.



**Table 4.4.**  
**Socio-economic characteristics in the malnourished group (intervention and control groups combined) and the adequately nourished group on enrolment**  
**(raw data)**

Variables	Malnourished Number (%) n=201 <sup>b</sup>	Adequately nourished Number (%) n=106 <sup>b</sup>	P value <sup>a</sup>
Location of water (Inside the house)	41 (71)	83 (78)	0.1
Sanitary latrine	53 (26)	50 (47)	<0.001
Housing			
Roof			0.09
Made of tin/cement	192 (96)	105 (99)	
Made of straw	9 (4)	1 (1)	
Wall			0.01
Made of straw/earth	165 (82)	74 (70)	
Made of tin or cement	36 (18)	32 (30)	
Electricity present	45 (22)	45 (43)	<0.001
Number of family members (range)	2-18	3-17	0.2
Number of bed rooms (only 1)	138 (69)	65 (61)	0.1
Assets			
Bed (≥2)	76 (38)	55 (52)	0.02
Table (≥1)	132 (66)	62 (59)	0.1
Chair (≥1)	160 (80)	79 (75)	0.2
Showcase (≥1)	43 (21)	36 (34)	0.01
Radio (≥1)	48 (24)	40 (38)	0.008
Cassette player (≥1)	27 (13)	31 (30)	0.001
TV (≥1)	17 (8.5)	27 (26)	<0.001
Fan (≥1)	24 (12)	29 (27)	0.001
Other electric goods (e.g. iron, etc. ≥1)	12 (6)	14 (13)	0.03
Bicycle (≥1)	60 (30)	38 (36)	0.2
Clock/watch (≥1)	96 (48)	72 (68)	0.001
Other valuables (e.g. jewellery, etc. ≥1)	80 (40)	67 (63)	<0.001
Animal ownership			
Cows (≥1)	86 (43)	45 (43)	0.5
Goats (≥1)	36 (18)	21 (20)	0.4
Chicken (≥5)	57 (28)	35 (33)	0.2

<sup>a</sup>= Chi-square test was conducted for all measurements.

<sup>b</sup>=Two mothers of children from the malnourished group and one from the adequately nourished group could not be interviewed.

**Table 4.5.**

**Socio-economic indices in the malnourished intervention and control groups combined and the adequately nourished group on enrolment**

Variables <sup>a</sup>	Malnourished Mean (SD) n=201 <sup>d</sup>	Adequately nourished Mean (SD) n=106 <sup>d</sup>	P value <sup>c</sup>
Sanitation index	1.0 (0.7)	1.3 (0.7)	0.001
Housing index	1.4 (0.7)	1.7 (0.8)	<0.001
Assets index	4.2 (1.9)	5.2 (2.5)	<0.001
Animals index	1.5 (0.8)	1.6 (0.8)	0.6
Crowding index (median (range)) <sup>b</sup>	4.0 (10.5)	4.0 (11)	0.1

a= Indices are described in methods, b=Crowding was not normally distributed and therefore it is shown as median and range, c=Independent sample t-test, d=Two mothers of children from the malnourished group and one from the adequately nourished group could not be interviewed.

#### *Relations of MDI and PDI with age and gender*

Bivariate correlations were conducted for each nutritional group separately to examine the relationship of the developmental and behavioural variables with age and gender.

Age at the time of testing was significantly negatively correlated to MDI and positively with activity and vocalisation in both the groups. Age was also significantly correlated to approach and emotional tone in the adequately nourished group. None of the developmental or behavioural variables varied significantly by gender. Since age at the time of testing was significantly correlated to most of the variables, we controlled for age in the rest of the analyses.

**Table 4.6.**

**Mean scores of the subscales and total scale of the HOME<sup>a</sup> in the intervention and control malnourished groups combined and the adequately nourished group 3 to 6 months after enrolment**

Variables	Malnourished Mean (SD) n=201 <sup>c</sup>	Adequately nourished Mean (SD) n=106 <sup>c</sup>	P value <sup>b</sup>
Physical environment scale	17.6 (2.0)	18.2 (2.2)	0.02
Stimulation scale	15.6 (2.0)	16.6 (1.8)	<0.001
Maternal involvement scale	8.9 (1.1)	9.2 (0.9)	0.01
Play materials scale	15.7 (2.3)	15.9 (2.5)	0.5
Punishment scale	5.4 (1.2)	5.3 (1.1)	0.3
Emotional responsiveness scale	11.8 (1.9)	12.1 (1.7)	0.3
Total HOME scale	75.1 (6.1)	77.3 (5.5)	0.001

a =HOME= Home Observation for Measurement of Environment, b=Independent sample t-test, c=Two children from the malnourished group and one from the adequately nourished group could not be interviewed at home.

*Bivariate relationships among the development and behavioural measures on enrolment*

We examined the relationship among the Bayley scores and behavioural ratings controlling for age (Table 4.7.). In both of the groups, MDI and PDI were significantly moderately correlated to each other.

In the malnourished group, all of the behavioural ratings and MDI and PDI were significantly correlated to each other with low to moderate correlations. Approach was an exception in that it was not significantly correlated to PDI (Table 4.7.A).

In the adequately nourished group, there was no significant correlation between PDI and any of the four behavioural ratings. However there were only half the number of adequately nourished children. Except for the activity rating, which was not significantly correlated to MDI or to cooperation, all other behaviour ratings were correlated to MDI and to each other (Table 4.7.B).

**Table 4.7.**

**Partial correlations among the developmental and behavioral measures on enrolment controlling for age**

*4.7. A. Combined malnourished groups (n=203)*

Variables	MDI	PDI	Approach	Emotional tone	Activity	Coop eration	Vocalis ation
PDI	0.46**	—	—	—	—	—	—
Approach	0.18*	0.14	—	—	—	—	—
Emotional tone	0.30**	0.26**	0.51**	—	—	—	—
Activity	0.15*	0.19**	0.23**	0.31**	—	—	—
Cooperation	0.29**	0.23*	0.42**	0.85**	0.27**	—	—
Vocalisation	0.39**	0.23**	0.39**	0.41**	0.24**	0.32**	—
Age <sup>#</sup>	-0.50**	-0.09	0.06	0.09	0.19**	0.06	0.29**

*4.7. B. Adequately nourished group (n=107)*

Variables	MDI	PDI	Approach	Emotion al tone	Activity	Co-op eration	Vocalis ation
PDI	0.42**	—	—	—	—	—	—
Approach	0.25**	-0.01	—	—	—	—	—
Emotional tone	0.22*	0.11	0.52**	—	—	—	—
Activity	0.16	0.09	0.21**	0.32**	—	—	—
Cooperation	0.23*	0.004	0.45**	0.77**	0.11	—	—
Vocalisation	0.44**	0.17	0.42**	0.35**	0.41**	0.26**	—
Age <sup>#</sup>	-0.57**	-0.12	0.20*	0.28**	0.36**	0.15	0.66**

# Bivariate correlation, \*  $p < 0.05$ , \*\*  $p < 0.01$

*Bivariate relations of the development and behavioural measures with child's nutritional status*

We then conducted partial correlations of Bayley scores and behaviour ratings on enrolment with child's concurrent anthropometric measures, controlling for age (Table 4.8). In the malnourished group MDI was significantly positively correlated with children's head circumference, weight-for-age and height-for-age and surprisingly was negatively correlated with weight-for-height. PDI was

significantly associated with child's MUAC, weight-for-age and height-for-age (Table 4.8.A). In marked contrast, in the adequately nourished group there was no association between the child's nutritional status and Bayley scores (Table 4.8.B).

In the malnourished group MUAC was significantly correlated to approach, activity and cooperation. Weight-for-age was significantly correlated to activity and vocalisation. Height-for-age was significantly correlated to activity, cooperation and vocalisation (Table 4.8.A). In the adequately nourished group MUAC was significantly correlated to emotional tone. Weight-for-age and weight-for-height were significantly correlated to emotional tone and cooperation (Table 4.8.B).

As there was a significant negative association between MDI and weight-for-height in the malnourished group we looked at the correlation between weight-for-age and height-for-age and found a significant negative correlation between the two scores in the malnourished group ( $r = -0.27$ ,  $p < 0.001$ ). It is likely that the more stunted children were less wasted and that MDI was more affected by stunting.

#### *Bivariate relations of the child's development and behavioural measures with socio-economic variables*

Mothers' knowledge of parenting score was significantly associated with MDI and PDI in the adequately nourished group but was not related to any of the developmental and behavioural ratings in the malnourished group. Mothers' knowledge of health and hygiene was significantly associated with PDI in the malnourished group and with PDI, MDI and vocalisation rating in the adequately nourished group. Mother's current nutritional status as measured by BMI was related to MDI in the adequately nourished group but not in the malnourished group. Mothers' education was related to MDI, PDI, emotional tone cooperation, and vocalisation in the malnourished group but not to any of the developmental scales or behavioural ratings in the adequately nourished group. Father's education was related to approach and emotional tone in the malnourished group and to PDI in the adequately nourished group. Father's occupation was significantly related to MDI in the malnourished group only. The total HOME score, the maternal involvement and play materials subscales were significantly related to the PDI and total HOME score was also related to emotional tone in the malnourished group. In

the adequately nourished group cooperation was significantly related to total HOME scale and significantly but negatively correlated to maternal involvement (Table 4.9 A and B). None of the other socio-economic indices were significantly associated with the developmental scales or behavioural ratings in either group.

**Table 4.8.**

**Significant partial correlations of the developmental measures and child nutritional status in the malnourished group (intervention and control groups combined) and the adequately nourished group on enrolment controlling for age**

*4.8A Combined malnourished groups (n=203)*

Variables	Head circumference (cm)	MUAC (cm)	WHZ	WAZ	HAZ
MDI	0.15*	0.11	-0.21**	0.30**	0.43**
PDI	0.06	0.23**	-0.13	0.40**	0.47**
Approach	-0.01	0.14*	-0.005	0.13	0.13
Emotional tone	-0.03	0.13	-0.03	0.12	0.13
Activity	-0.03	0.29**	0.10	0.24**	0.15*
Cooperation	-0.06	0.11	-0.07	0.12	0.16*
Vocalisation	0.06	0.19**	-0.04	0.23**	0.24**

*4.8 B Adequately nourished group (n=107)*

Variables	Head circumference (cm)	MUAC (cm)	WHZ	WAZ	HAZ
MDI	0.10	0.10	-0.02	0.05	0.10
PDI	0.003	0.05	-0.11	-0.04	0.09
Approach	-0.10	0.14	0.09	0.18	0.17
Emotional tone	-0.005	0.21*	0.22*	0.25**	0.14
Activity	0.06	0.10	0.10	0.07	0.03
Cooperation	0.02	0.19	0.21*	0.24*	0.11
Vocalisation	0.03	0.05	0.05	0.03	0.009

MUAC: mid-upper arm circumference, WHZ: weight-for-height z score WAZ: weight-for-age z score, HAZ: height-for-age z score

**Table 4.9.**

**Significant partial correlations of the developmental and behavioural variables with family background variables on enrolment**

*4.9 A. Combined malnourished groups (n=203)*

Variables	Parent- ing	Health	BMI	Edu-M	Edu-F	Occ-F	HOME- T	Pl. Mat.	Mat. Inv.
MDI	0.11	-0.007	0.07	0.17*	0.09	0.17*	0.14	0.12	0.07
PDI	0.05	0.17*	0.13	0.16*	0.10	0.12	0.15*	0.17*	0.15*
Approach	-0.04	0.06	-0.02	0.11	0.18*	0.01	0.07	-0.005	0.03
Emotional tone	0.05	0.11	0.01	0.21**	0.22**	-0.008	0.16*	0.13	0.13
Activity	0.09	0.07	0.06	0.03	0.07	0.02	0.003	-0.02	0.04
Cooperation	0.01	0.10	0.02	0.19**	0.13	-0.03	0.08	0.06	0.10
Vocalisation	0.12	0.06	-0.003	0.17*	0.11	0.09	0.11	0.12	0.04

*4.9 B. Adequately nourished group (n=107)*

Variables	Parent- ing	Health	BMI	Edu-M	Edu-F	Occ-F	HOME- T	Pl. Mat.	Mat. Inv.
MDI	0.20*	0.19*	0.21*	0.14	0.11	0.05	0.10	0.07	0.17
PDI	0.19*	0.31**	0.15	0.14	0.21*	0.03	0.10	0.13	0.13
Approach	0.02	0.07	0.006	0.03	-0.04	-0.09	0.05	-0.04	0.14
Emotional tone	0.09	0.10	0.02	-0.03	-0.03	-0.10	0.13	0.07	-0.15
Activity	0.07	0.13	-0.06	0.002	0.06	0.12	0.09	0.10	0.08
Cooperation	0.08	0.03	0.06	0.05	0.005	0.11	0.22*	0.15	-0.19*
Vocalisation	0.06	0.31**	0.07	0.14	0.13	0.12	0.11	0.03	0.13

Parenting= mother's parenting knowledge score, Health= mother's health and hygiene knowledge score, BM= body mass index (Kg/m<sup>2</sup>) Edu-M= mother's 5 years of schooling, Edu-F= father's 5 years of schooling, Occ-F= father's occupation, HOME-T= Total HOME score, Pl. Mat.= Play materials, Mat. Inv.= Maternal involvement

*Multiple regression*

Multiple regression analyses were conducted to determine if the differences at enrolment between malnourished and adequately nourished children in MDI and PDI remained after controlling for differences in socio-economic variables (Table 4.10). The model was as follows: age and all the socio-economic variables that were significantly correlated with MDI or were different between the groups, were

offered in the first block. These were fathers' occupation, mothers' and fathers' education, assets, housing, sanitation, and mothers' knowledge of child rearing and health and hygiene. In the second block, the nutritional group was entered. The difference between the two groups was no longer significant in MDI after controlling for all the socio economic variables but the adequately nourished children remained significantly better in their PDI (Table 4.10. Model-1). Age and mothers' education were significant predictors of MDI. In case of PDI only mothers' knowledge of health and hygiene entered the equation. We then examined a number of interactions between the nutritional group and other variables and offered them as additional variables. The interactions calculated were between group and age, group and mothers' education, group and health knowledge. None of the interactions entered the equation.

We had defined the nutritional groups by weight-for-age, however there is some evidence that height-for-age is more likely to predict psychomotor development and in the bivariate correlation, height-for-age was strongly correlated with the Bayley scores in the malnourished group. We therefore examined the effect of height-for-age instead of groups, in another regression. In addition, weight-for-height had a surprising inverse relation with MDI in the malnourished groups in bivariate analysis that we wanted to explore further so weight-for-height was also offered.

We repeated the same model as above but entered height-for-age z score instead of nutritional group. Height of the children was highly significant in both MDI and PDI ( $p < 0.001$  for both) and more of the variance was explained. Age and mothers' education were still significant predictors of MDI ( $p < 0.001$ ,  $p = 0.03$  respectively) and mothers' knowledge of health and hygiene was a significant predictor of PDI ( $p = 0.004$ ) (Table 4.10. Model-2). We then entered weight-for-height z score in the above model instead of height-for-age but there was no significant effect of weight-for-height on MDI or PDI. In another model we offered weight-for-height and entered height-for-age but weight-for-height did not enter the equation.



**Table 4.10.**

**Significant regression coefficients (B), standard errors (se) and 95% confidence intervals (95%CI) from regression of MDI and PDI at enrolment, examining the effect of nutritional groups and height-for-age**

Variables	MDI		PDI	
	B (se, 95%CI)	p-value	B (se, 95%CI)	p-value
<i>Model 1</i>				
Age at test (months)	-1.6 (0.2, -1.9,-1.3)	<0.001	----	----
Maternal education	4.0 (1.4, 1.2,6.8)	0.005	-----	----
Health knowledge	-----	-----	1.2 (0.3, 0.5,1.8)	0.001
Groups according to nutrition	2.0 (1.5, -1.0,5.0)	0.2	9.3 (1.9, 5.6,13.0)	<0.001
R <sup>2</sup>	0.29		0.12	
<i>Model 2</i>				
Age at test (months)	-1.5 (0.15, -1.7,-1.2)	<0.001	-----	----
Maternal education	3.0 (1.4, 0.3,5.7)	0.03	-----	----
Health knowledge	-----	-----	0.9 (0.3, 0.3,1.5)	0.004
Height-for-age Z score at enrolment	3.5 (0.6, 2.4,4.6)	<0.001	6.1 (0.7, 4.7,7.5)	<0.001
R <sup>2</sup>	0.37		0.24	

**Model 1:**

Step 1: Age, mothers' knowledge of child rearing, & knowledge of health & hygiene, parents' education, fathers' occupation, assets, housing, and sanitation offered.

Step 2: Nutritional Group entered (malnourished=0, adequately nourished=1).

**Model 2:**

Same variables were offered in the first step and height-for-age and weight-for-height were entered in the second step.

Health knowledge= mother's health and hygiene knowledge score, Maternal education= mother's 5 years of schooling,

The behaviour ratings were not significantly different on independent sample t-test but we noticed a significantly high correlation of vocalisation with the age of the children in the adequately nourished group and a smaller one in the malnourished group (Table 4.7B). We therefore calculated the interaction between age and group

and entered it in the multiple regression model predicting vocalisation. In the first block we entered age and mothers' education and in the second block we entered the nutritional group and age-group interaction. Child's age, mothers' education and age-group interaction were all significant predictors of vocalisation (Table 4.11.).

We then separated the children below and above the mean age i.e. 14.5 months and found that the older children in adequately nourished group vocalised significantly more than the older children in the malnourished group. There was no significant difference in vocalisation between the groups in younger children. We then checked to see if there were any differences in the groups between the younger and older children in any of the other behavioural ratings and found no significant difference between the groups.

**Table 4.11**

**Significant regression coefficients (B), standard errors (se) and 95% confidence intervals (95%CI) from regression of vocalisation at enrolment, between the nutritional groups**

Variables	Vocalisation	
	B (se, 95%CI)	p-value
Age at test (months)	1.6 (0.02, 0.12, 0.2)	<0.001
Maternal education	0.5 (0.19, 0.15, 0.9)	0.006
Nutritional group	0.3 (0.2, -0.1, 0.7)	0.2
Age and group interaction	0.14 (0.04, 0.2, 0.7)	0.001
R <sup>2</sup>	0.23	

Model:

Step 1: Age, mothers' knowledge of child rearing, & knowledge of health & Hygiene, parents' education, fathers' occupation, assets, housing, and sanitation offered.

Step 2: Nutritional Group (malnourished=0, adequately nourished=1) and group/age interaction entered.

Maternal education= mother's 5 years of schooling

### 4.3. COMPARISON OF THE TWO MALNOURISHED GROUPS ON ENROLMENT AND AT THE END OF INTERVENTION

#### *Sample characteristics*

We examined the characteristics of the two malnourished groups on enrolment to determine whether randomisation was successful in selecting similar groups. The sample included 35% and 29% severely malnourished children (weight-for-age z score  $<-3$ ) in the intervention and control groups respectively. There were 33.7% and 27.5% severely stunted children (height-for-age z score  $<-3$ ) in the intervention and control group respectively. Moderate wasting (weight-for-height z score  $>-3$  and  $<-2$ ) was 21.8% and 22.5% in the intervention and control groups respectively and there was one severely wasted child ( $<-3$  SD) in the control group. There was no difference between the groups in anthropometric measurements or gender distribution (Table 4.12.).

**Table 4.12.**  
**Characteristics of the intervention and control malnourished groups on enrolment**

Variable	Intervention Mean (SD) N=101	Control Mean (SD) N=102	P value <sup>a</sup>
Age at enrolment (months)	14.5 (4.5)	14.9 (4.3)	0.6
Sex (boys %)	43%	52%	0.1 <sup>b</sup>
MUAC (cm)	12.7 (0.9)	12.6 (0.9)	0.7
Head Circumference (cm)	43.5 (1.7)	43.9 (1.7)	0.1
BMI (Kg/m <sup>2</sup> )	14.8 (1.0)	14.8 (1.2)	1.0
HAZ score	-2.6 (1.2)	-2.6 (1.0)	0.7
WAZ score	-2.8 (0.7)	-2.8 (0.7)	0.9
WHZ score	-1.4 (0.7)	-1.5 (0.7)	0.3

a=Independent sample t-test was conducted for all measurements except for (b) where Chi-square test was conducted.

Their parents' characteristics were similar except that the control children had less educated fathers ( $p=0.03$ ) than the intervened children (Table 4.13.) and there was no difference in any of the SES variables (Table 4.14.). Baseline developmental

and behavioural outcomes were similar between the two malnourished groups (Table 4.15.). Since the assessment of home stimulation was conducted between 3-6 months of the initiation of the intervention, no comparison was made between the two groups.

**Table 4.13.**  
**Characteristics of parents of intervention and control malnourished groups on enrolment**

Variable	Intervention Mean (SD) N=101	Control Mean (SD) N=102	P value <sup>a</sup>
Mother's BMI (Kg/m <sup>2</sup> )	18.2 (1.9)	18.0 (1.6)	0.5
Mothers' MUAC (cm)	21.7 (2.0)	21.6 (1.7)	0.5
Mothers education (<5yrs of schooling)	52%	57%	0.3 <sup>b</sup>
Father's education (<5 yrs of schooling)	49%	63%	0.03 <sup>b</sup>
Fathers' occupation (Very Poor)	64%	73%	0.1 <sup>b</sup>
Score of mother's parenting knowledge	15.5 (3.5)	15.2 (3.4)	0.6
Score of mother's health knowledge	5.9 (2.9)	5.6 (2.5)	0.4

a=Independent sample t-test was conducted for all measurements except for (b) where Chi-square test was conducted.

**Table 4.14**  
**Socio-economic characteristics of the intervention and control malnourished groups on enrolment**

Variable	Intervention Mean (SD) N=99 <sup>b</sup>	Control Mean (SD) N=102	P value <sup>a</sup>
Sanitation index	1.0 (0.7)	0.9 (0.7)	0.2
Housing index	1.4 (0.6)	1.3 (0.7)	0.6
Assets index	4.3 (1.9)	4.2 (1.8)	0.6
Animals index	1.5 (0.9)	1.6 (0.8)	0.8
Crowding index	0.6 (0.2)	0.6 (0.2)	0.9
Median (Range)	4.0 (6.5)	4.0 (10.5)	

a=Independent sample t-test, b=Two mothers of children from the intervened malnourished group could not be interviewed.

**Table 4.15**  
**Bayley scores and behaviour ratings of the intervention and control malnourished groups on enrolment**

Variable	Intervention Mean (SD) N=101	Control Mean (SD) N=102	P value <sup>a</sup>
MDI	88.5 (15.5)	90.1 (15.1)	0.5
PDI	82.7 (17.6)	86.3 (17.1)	0.1
Approach	6.3 (1.2)	6.0 (1.3)	0.1
Emotional tone	5.4 (1.7)	5.6 (1.4)	0.3
Activity	4.7 (1.2)	4.6 (1.1)	0.4
Cooperativeness	5.6 (1.7)	5.9 (1.6)	0.1
Vocalisation	3.6 (1.9)	4.0 (1.6)	0.2

a=Independent sample t-test

#### *Treatment effect*

Table 4.16. illustrates the children's age and nutritional status at the end of intervention. There was no significant difference between the groups at the end of intervention.

**Table 4.16**  
**Characteristics of intervention and control malnourished groups at the end of study**

Variables	Intervention Mean (SD) n=92	Control Mean (SD) n=101	P value <sup>a</sup>
Age (months)	26.9 (4.6)	26.9 (4.3)	0.9
MUAC (cm)	13.3 (0.9)	13.0 (0.7)	0.1
Head Circumference (cm)	45.4 (1.4)	45.6 (1.5)	0.3
BMI (Kg/m <sup>2</sup> )	14.5 (1.0)	14.4 (0.9)	0.5
HAZ score	-2.6 (0.9)	-2.5 (1.0)	0.6
WAZ score	-2.7 (0.7)	-2.8 (0.6)	0.8
WHZ score	-1.6 (0.6)	-1.7 (0.6)	0.4

a=Independent sample t-test

Their mothers had similar nutritional status but mothers' knowledge of child rearing was significantly better in the intervention group (t-test:  $p < 0.001$ ) (Table 4.17.). There were significant differences in MDI ( $p = 0.03$ ), approach ( $p = 0.001$ ), and cooperation ( $p = 0.01$ ) and an approaching significance in emotional tone ( $p = 0.06$ ) in favour of the intervention group (Table 4.18.).

**Table 4.17.**  
**Characteristics of parents of the intervention and control malnourished groups at the end of study**

Variable	Intervention Mean (SD) N=92	Control Mean (SD) N=101	P value <sup>a</sup>
Mother's BMI (Kg/m <sup>2</sup> )	18.6 (2.2)	18.2 (1.9)	0.2
Mothers' MUAC (cm)	22.2 (1.9)	21.9 (1.7)	0.3
Mothers' parenting knowledge scale	19.0 (3.8)	15.2 (3.5)	<0.001
Mothers' health knowledge scale	6.2 (2.6)	5.7 (2.5)	0.2

a=Independent sample t-test

**Table 4.18.**  
**Developmental and behavioural differences between the intervention and control malnourished groups at the end of study**

Variable	Intervention Mean (SD) N=92	Control Mean (SD) N=101	P value <sup>a</sup>
MDI	87.6 (13.3)	82.7 (17.2)	0.03
PDI	93.0 (16.4)	90.2 (17.4)	0.2
Approach	6.0 (1.0)	5.5 (1.1)	0.001
Emotional tone	5.5 (1.1)	5.2 (1.2)	0.06
Activity	4.2 (1.2)	4.2 (1.3)	0.9
Cooperation	5.6 (1.1)	5.2 (1.1)	0.01
Vocalisation	4.4 (1.7)	4.0 (1.8)	0.1

a=Independent sample t-test

To examine the effect of treatment, a series of multiple regression analyses were conducted using only the malnourished children. In the model, the post-intervention outcome variable was predicted, with the relevant baseline measurement, and age (if correlated with the outcome variable) that were entered in the first step, then father's education, which was initially different between the groups, was offered in the second step and the treatment was entered in the third step.

### Mothers' knowledge

The mothers' knowledge of child rearing was significantly improved by treatment ( $p<0.001$ ) and the baseline score significantly predicted the final score ( $p<0.001$ ) (Table 4.19.). There was no effect of treatment on mother's knowledge of health and hygiene but baseline score and fathers' education were significant predictors of mothers' knowledge of health and hygiene ( $p<0.001$  and  $p=0.003$  respectively) at the end of the year.

**Table 4.19.**  
Significant regression coefficients (B), standard errors (se),  
and 95% confidence intervals (95%CI) from regression of mothers' knowledge of  
child rearing and health and hygiene for the effect of intervention

Variables	Child rearing		Health and hygiene	
	B (se, 95%CI)	p-value	B (se, 95%CI)	p-value
Baseline scores	0.4 (0.1, 0.3, 0.6)	<0.001	0.6 (0.05, 0.5, 0.7)	<0.001
Fathers' education	-----	----	0.8 (0.3, 0.3, 1.3)	0.003
Treatment	-3.6 (0.5, -4.5, -2.6)	<0.001	-0.2 (0.3, -0.7, 0.3)	0.4
R <sup>2</sup>	0.33		0.53	

### **Model:**

Step 1. Baseline knowledge entered. Step 2. Fathers' education offered.

Step 3. Treatment entered.

Fathers' education= father's 5 years of schooling

### Developmental levels and behaviour

There was a significant treatment effect on MDI ( $p=0.02$ ) and the effect approached significant levels in PDI ( $p=0.1$ ) (Table 4.20.). Initial scores, age and fathers' education were significant in both regressions. There were also significant treatment effects in the following ratings: approach ( $p=0.002$ ), cooperation ( $p=0.02$ ), emotional tone ( $p=0.05$ ) (Table 4.21.) and vocalisation ( $p=0.04$ ) ratings (Table 4.22.). The intervened children were more friendly, more cooperative, happier, and vocalised more than the control children. There was no significant effect of treatment on the activity rating of the children. Age was significant in the regression of activity and vocalisation and older children were less active but vocalised more than the younger ones (Table 4.22.).

**Table 4.20.**  
**Significant regression coefficients (B), standard errors (se),**  
**and 95% confidence intervals (95%CI) from regression of MDI and PDI for the**  
**effect of intervention**

Variables	MDI		PDI	
	B (se, 95%CI)	p-value	B (se, 95%CI)	p-value
Baseline scores	0.4 (0.08, 0.26, 0.57)	<0.001	0.39 (0.07, 0.26, 0.52)	<0.001
Age (months)	1.4 (0.3, 0.9, 1.9)	<0.001	-0.59 (0.25, -1.08, -0.1)	0.02
Father's Education	5.1 (2.1, 1.1, 9.2)	0.01	4.9 (2.2, 0.5, 9.3)	0.03
Treatment	-4.8 (2.0, -8.8, -0.8)	0.02	-3.5 (2.2, -7.8, 0.9)	0.1
R <sup>2</sup>	0.21		0.21	

Model:

Step 1. Baseline MDI/PDI and age at enrolment entered. Step 2. Fathers' education offered. Step 3. Treatment entered.

Fathers' education= father's 5 years of schooling

### *Interaction*

To examine whether treatment affected certain types of children differently we examined several possible interactions with treatment. Interaction of treatment with age, sex, children's enrolment height-for-age, and mothers' and fathers' education were calculated. They were all offered as extra variables in the multiple regressions using the above model to detect treatment effects but none of them entered the equation.



**Table 4.21.**  
**Significant regression coefficients (B), standard errors (se),**  
**and 95% confidence intervals (95%CI) from regression of approach, cooperation**  
**and emotional tone ratings, for the effect of intervention**

Variables	Approach		Cooperation		Emotional tone	
	B (se, 95%CI)	p-value	B (se, 95%CI)	p-value	B (se, 95%CI)	p-value
Baseline ratings	0.2(0.1, 0.04,0.3)	0.01	0.1 (0.05, -0.005, 0.2)	0.06	0.1 (0.05, 0.01,0.2)	0.03
Father's Education	—	—	0.3 (0.16, -0.04,0.6)	0.08	—	—
Treatment	-0.5 (0.2, -0.8,-0.2)	0.002	-0.4 (0.2, -0.7,-0.07)	0.02	-0.6 (0.16, -0.6,-0.001)	0.05
R <sup>2</sup>	0.08		0.06		0.03	

Model:

Step 1. Baseline ratings entered. Step 2. Fathers' education offered. Step 3. Treatment entered. Fathers' education= father's 5 years of schooling

**Table 4.22.**  
**Significant regression coefficients (B), standard errors (se),**  
**and 95% confidence intervals (95%CI) from regression of activity and**  
**vocalisation ratings, for the effect of intervention**

Variables	Activity		Vocalisation	
	B (se, 95%CI)	p-value	B (se, 95%CI)	p-value
Baseline ratings	0.2 (0.1, 0.07,0.4)	0.005	0.3 (0.1, 0.2,0.5)	<0.001
Age	-0.04 (0.02, -0.09,-0.004)	0.03	0.08 (0.03, 0.02,0.13)	0.005
Treatment	0.04 (0.2, -0.3,0.4)	0.9	-0.5 (0.2, -0.9,-0.03)	0.04
R <sup>2</sup>	0.04		0.18	

Model:

Step 1. Baseline ratings and age entered. Step 2. Fathers' education offered.  
Step 3. Treatment entered.

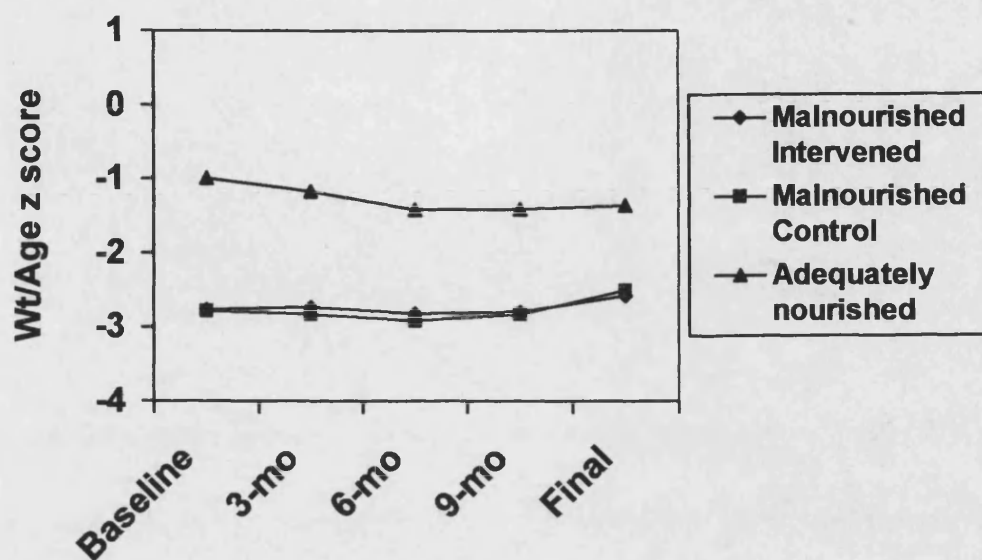
### *Multilevel modelling*

We reran all the analyses controlling for among-villages variance by using multilevel modelling regression analyses (Goldstein et al. 1998) with the malnourished children only. The treatment effects remained unchanged and the among-villages variance was not significant in any of the equations. We are therefore only reporting the multiple regression analyses for simplicity. However, the results of the multilevel modelling analyses are presented in chapter 7.9.

### *Treatment effect on growth*

The malnourished children in neither the intervention nor the control group showed improvement in their nutritional status in height-for-age, weight-for-height or weight-for-age. The anthropometric measurements throughout the study are shown in figures 4.1-4.5.

**Figure 4.1. Weight-for-age z scores in the 3 groups by the time of assessment:**



**Figure 4.2. Height-for-age z scores in the 3 groups by the time of assessment:**

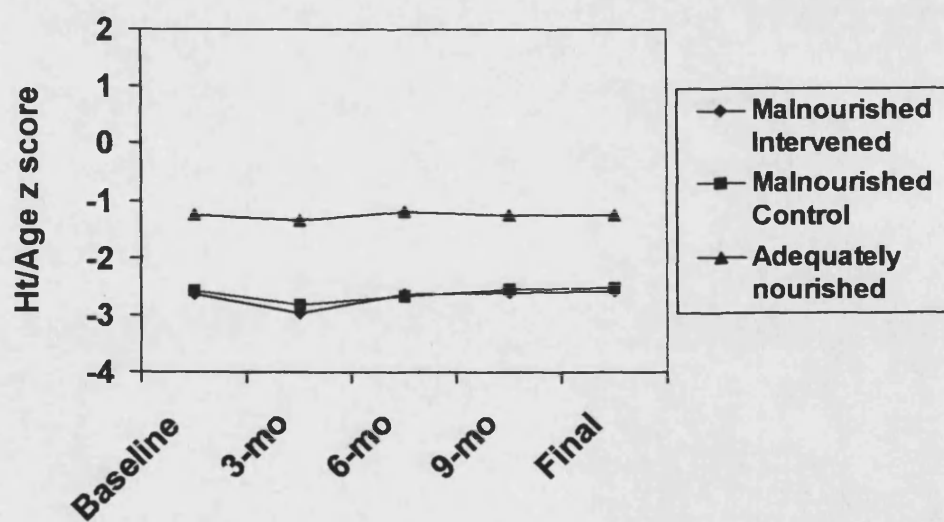


Figure 4.3. Weight-for-height z scores in the 3 groups by the time of assessment:

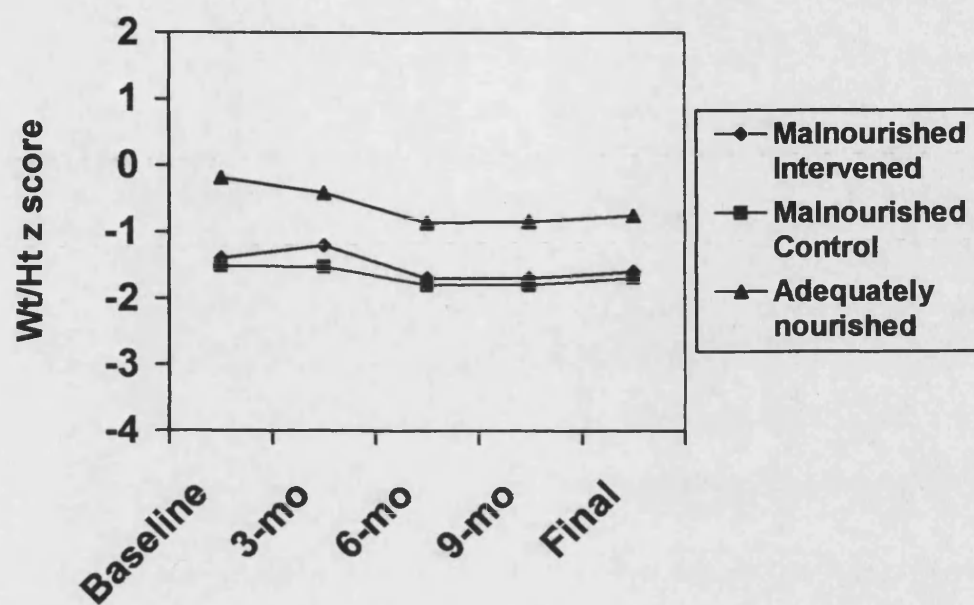
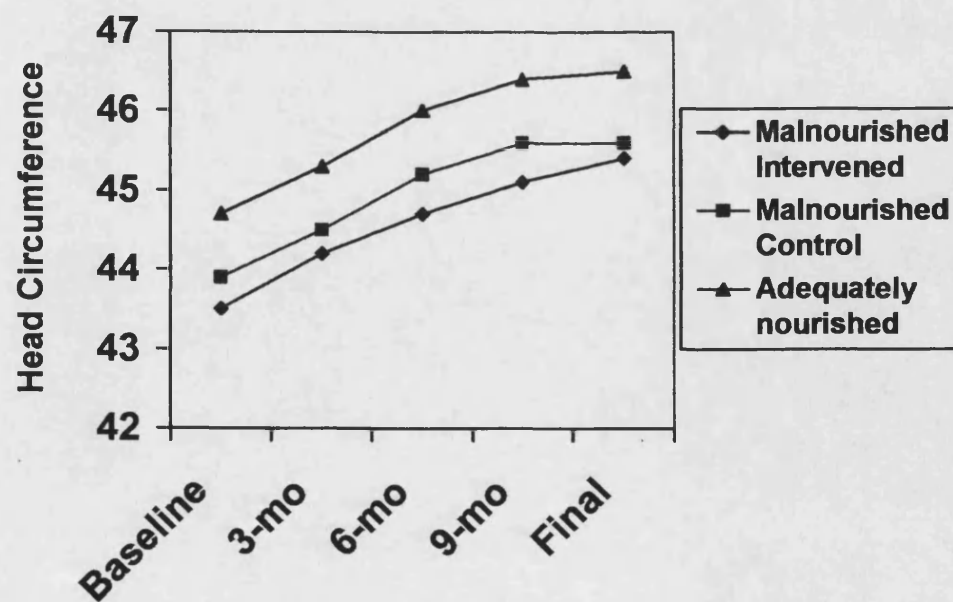
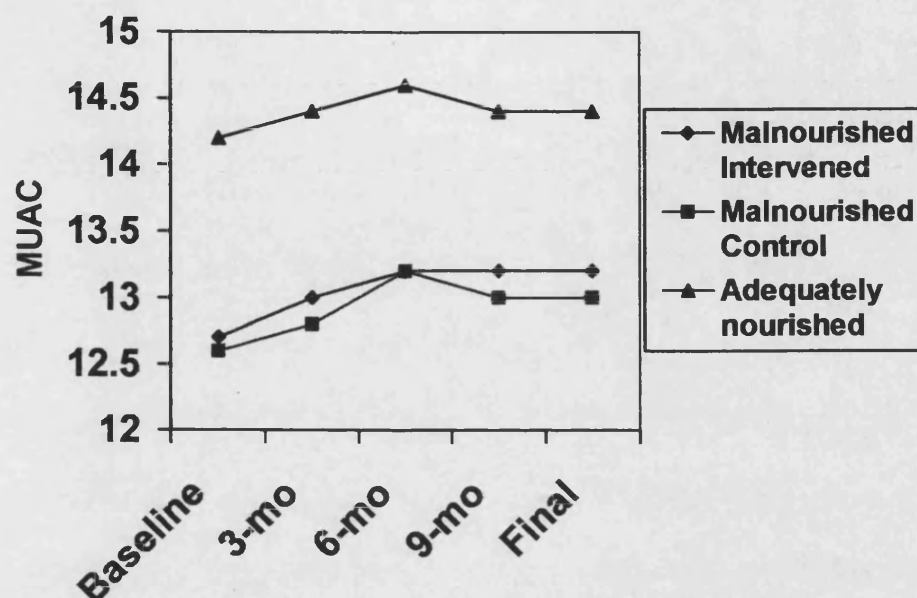


Figure 4.4. Head Circumference in the 3 groups by the time of assessment:



**Figure 4.5. Mid-Upper arm Circumference (MUAC) in the 3 groups by the time of assessment:**



To determine if the treatment had any effect on growth of the children, we conducted multiple regression analyses of the final measurements. We used the actual measurement and not z score. The initial measurements, age and sex were entered first, then father's education (which was different between the intervened and control malnourished groups at enrolment) was offered and treatment was entered in the final step. Treatment did not have a significant effect on growth in any of the measurements (Tables 4.23.- 4.24.). Initial measurements predicted the final anthropometric measurements. Boys grew more than girls in head circumferences but were not significantly different in other measurements. In height and head circumference the younger children grew significantly more than the older children whereas the older children's MUAC increased significantly more than the younger ones. There was no effect of age on change in weight of the children. No other variable significantly affected growth.

**Table 4.23.**  
**Significant regression coefficients (B), standard errors (se),**  
**and 95% confidence intervals (95%CI) from regression of final height and**  
**weight, for the effect of intervention**

Variables	Height (cm)		Weight (Kg)	
	B (se, 95%CI)	p-value	B (se, 95%CI)	p-value
Baseline Measurements	0.9 (0.04, 0.8,1.0)	<0.001	1.0 (0.05,0.9, 1.1)	<0.001
Age (months)	-0.1(0.04, -0.2, -0.05)	0.002	-0.01 (0.01, -0.03,0.01)	0.4
Sex	0.07 (0.2, -0.4, 0.6)	0.8	0.03 (0.1,-0.1, 0.2)	0.6
Treatment	0.009 (0.2, -0.5, 0.5)	1.0	-0.04 (0.08, -0.2,0.1)	0.6
R <sup>2</sup>	0.85		0.76	

Model:

Step 1. Baseline measurements, age, and sex entered. Step 2. Fathers' education (5 years of schooling) offered. Step 3. Treatment entered.

**Table 4.24.**  
**Significant regression coefficients (B), standard errors (se),**  
**and 95% confidence intervals (95%CI) from regression of MUAC and head**  
**circumference for the effect of intervention**

Variables	MUAC (cm)		Head Circumference (cm)	
	B (se, 95%CI)	p-value	B (se, 95%CI)	p-value
Baseline Measurement	0.6 (0.06, 0.4,0.7)	<0.001	0.8 (0.04,0.7, 0.9)	<0.001
Age (months)	0.04 (0.01, 0.02, 0.06)	0.001	-0.06 (0.015, -0.9,-0.03)	<0.001
Sex	0.1 (0.1, -0.09, 0.3)	0.3	0.2 (0.1, -0.5,-0.004)	0.05
Treatment	-0.15 (0.1, -0.3, 0.03)	0.1	-0.09 (0.1, -0.3,0.1)	0.4
R <sup>2</sup>	0.39		0.75	

Model:

Step 1. Baseline measurements, age, and sex entered. Step 2. Fathers' education (5 years of schooling) offered. Step 3. Treatment entered.

### *Effect of growth on development*

We also examined whether the growth of the children during the study in height, weight or weight-for-height had any effect on the change in MDI and PDI. In a multiple regression analysis predicting final MDI or PDI we entered the initial MDI or PDI, age and sex of the children in the first step and the initial and final

weight or height and treatment group in the second step. There was no effect of growth in weight or height on change in MDI or PDI and the treatment effect remained unchanged for MDI and approached significance levels for PDI. In another regression predicting final MDI or PDI we entered the initial developmental indices in the first step and the initial and final weight-for-height z scores and treatment in the second step. There was no significant effect of change in weight-for-height z score on change in MDI or PDI however, when we controlled for the effect of weight-for-height, the effect of treatment on PDI was very close to significant levels. The treatment effect on PDI was  $B=-4.2$ ,  $se=2.2$ , 95% CI= $-8.6, 0.2$   $p=0.06$ .

#### **4.4. COMPARISON OF THE ADEQUATELY NOURISHED, AND INTERVENED AND CONTROL MALNOURISHED CHILDREN AT THE END OF INTERVENTION**

We conducted further series of multiple regression analyses to see if the intervened and control malnourished groups were different from the adequately nourished children at the end of the study after controlling for social background differences. We entered the initial age in the first step, and offered mothers' education and knowledge of health and hygiene, which were initially different among the groups and were correlated to developmental indices in the second step. In the third step we entered two dummy variables comparing the adequately nourished children with the intervened and control malnourished children respectively. We observed that in case of MDI the intervened children had similar scores to those of the adequately nourished children and there was no significant difference between the two groups (Table 4.25.). The control children however were now significantly behind the adequately nourished children. In case of PDI both the malnourished groups were still significantly behind the adequately nourished children. The difference in the control group was slightly larger than that in the intervened group (Table 4.25.).

**Table 4.25.**  
**Significant regression coefficients (B), standard errors (se),**  
**and 95% confidence intervals (95%CI) from regression of MDI and PDI**  
**comparing the control and intervened malnourished groups with the adequately**  
**nourished group at the end of the study**

Variable	MDI		PDI	
	B (se, 95%CI)	p-value	B (se, 95%CI)	p-value
Age (months)	0.5 (0.2, 0.2, 0.9)	0.003	-0.8 (0.2, -1.2,-0.4)	<0.001
Mothers' education	4.7 (1.8, 1.1, 8.3)	0.01	3.9 (2.0, -0.03, 7.8)	0.052
Health knowledge	0.6 (0.3, -0.08, 1.3)	0.08	0.7 (0.4, 0.003, 1.5)	0.05
Intervention group	-0.6 (2.0, -4.6, 3.4)	0.8	-4.6 (2.3, -9.0, -0.16)	0.04
Control group	-5.1 (2.0, -9.1, -1.1)	0.01	-6.7 (2.2, -11.1, -2.4)	0.003
R <sup>2</sup>	0.09		0.12	

Model:

Step 1. Age at enrolment entered. Step 2: mothers' education (5 years of schooling) and mothers' initial knowledge of health and hygiene score offered. Step 3: Groups entered

We then conducted similar analyses for the behaviour ratings and found that there was no significant difference between intervened malnourished and adequately nourished children in approach, cooperation (Table 4.26.), and vocalisation (Table 4.27.). The difference in the emotional tone approached significance levels with the intervened having slightly lower ratings ( $p=0.06$ ) (Table 4.26). On the other hand the control children had significantly lower ratings than the adequately nourished children in approach, cooperation (Table 4.26.), emotional tone, and vocalisation (Table 4.27.). In the case of activity ratings the model was not significant and is not therefore reported here.

Figures 4.6.-4.12. show the developmental scores and behavioural ratings of the three groups at baseline and final tests.



**Table 4.26.**

**Significant regression coefficients (B), standard errors (se), and 95% confidence intervals (95%CI) from regression of approach and cooperation comparing the control and intervened malnourished groups with the adequately nourished group at the end of the study**

Variable	Approach		Cooperation	
	B (se, 95%CI)	p-value	B (se, 95%CI)	p-value
Age	0.01 (0.01, -0.02, 0.05)	0.4	0.05 (0.01, 0.02, 0.08)	0.001
Mothers' education	--	--	0.3 (0.1, 0.07, 0.6)	0.01
Intervention group	-0.18 (0.16, -0.14, 0.5)	0.3	-0.14 (0.17, -0.5, 0.2)	0.4
Control group	-0.4 (0.15, -0.7, -0.07)	0.02	-0.5 (0.16, -0.9, -0.2)	0.001
R <sup>2</sup>	0.03		0.08	

Model:

Step 1. Age at enrolment entered. Step 2: mothers' education (5 years of schooling) and mothers' initial knowledge of health and hygiene score offered. Step 3: Groups entered

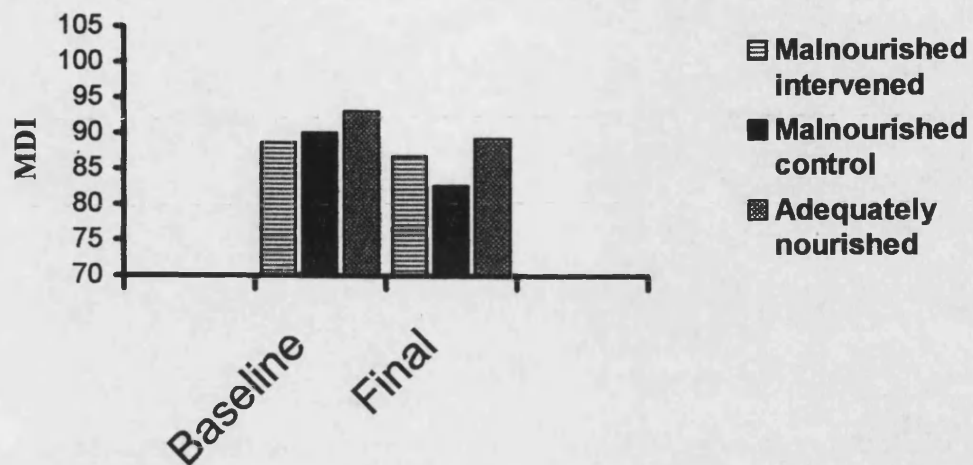
**Table 4.27**

**Significant regression coefficients (B), standard errors (se), and 95% confidence intervals (95%CI) from regression of emotional tone and vocalisation comparing the control and intervened malnourished groups with the adequately nourished group at the end of the study**

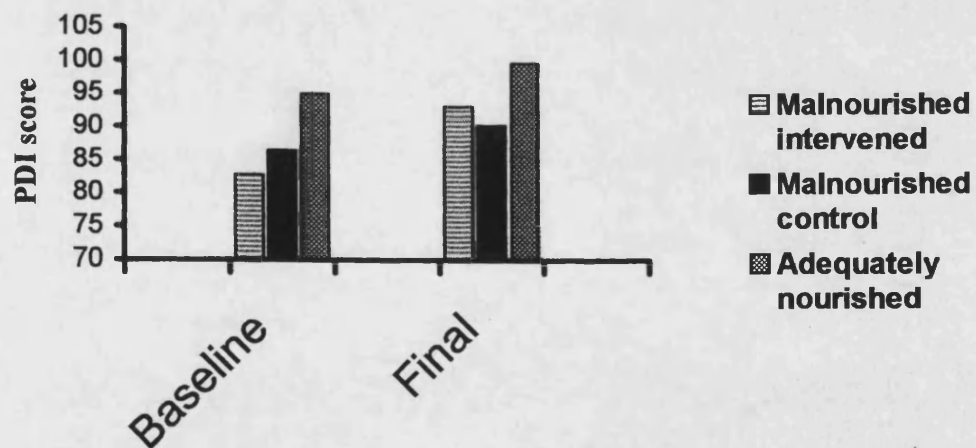
Variables	Emotional tone		Vocalisation	
	B (se, 95%CI)	p-value	B (se, 95%CI)	p-value
Age (months)	0.06 (0.01, 0.04, 0.09)	<0.001	0.1 (0.02, 0.07, 0.15)	<0.001
Mothers' education	0.3 (0.1, 0.02, 0.5)	0.04	0.4 (0.2, 0.04, 0.8)	0.03
Intervention group	-0.3 (0.16, -0.6, 0.1)	0.06	-0.4 (0.2, -0.8, 0.7)	0.1
Control group	-0.6 (0.16, -0.9, -0.3)	<0.001	-0.8 (0.2, -1.2, -0.3)	0.001
R <sup>2</sup>	0.11		0.12	

Model: Step 1. Age at enrolment entered. Step 2: Mothers' education (5 years of schooling) and mothers' initial knowledge of health and hygiene offered. Step 3: Groups entered

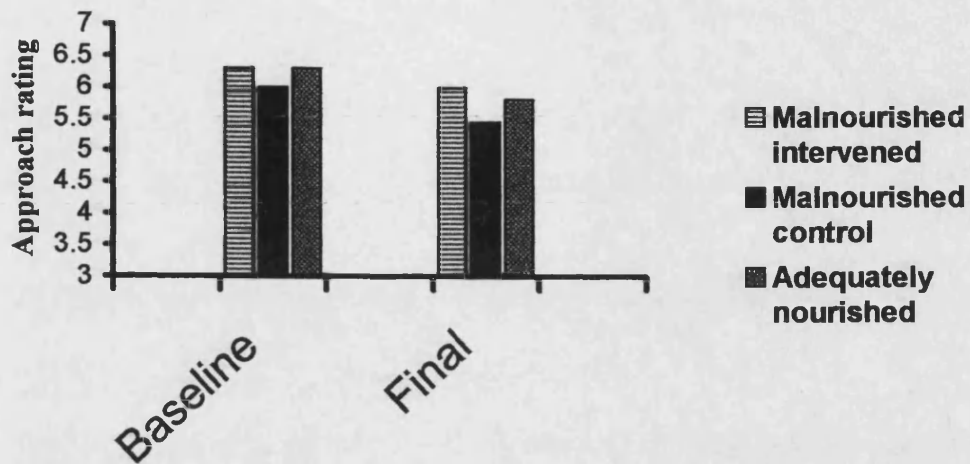
**Figure 4.6. MDI in the 3 groups at beginning and end of intervention**



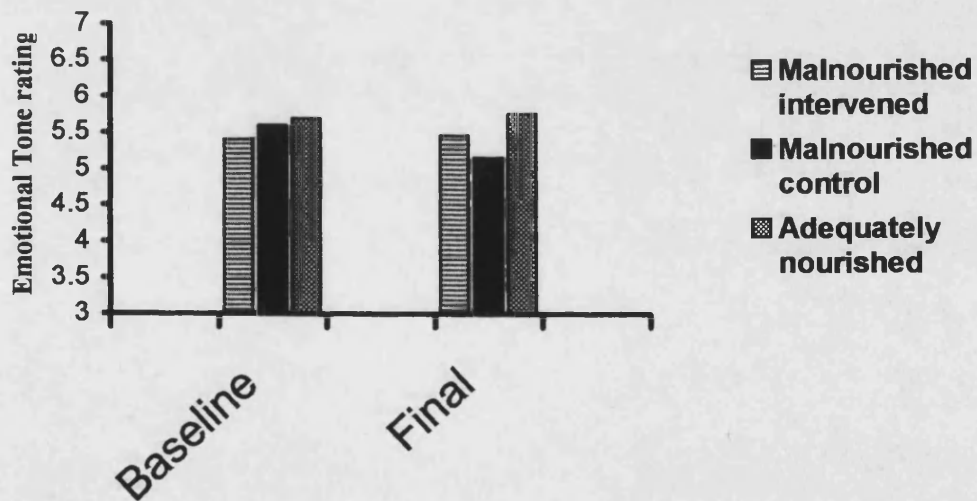
**Figure 4.7. PDI in the 3 groups at beginning and end of intervention**



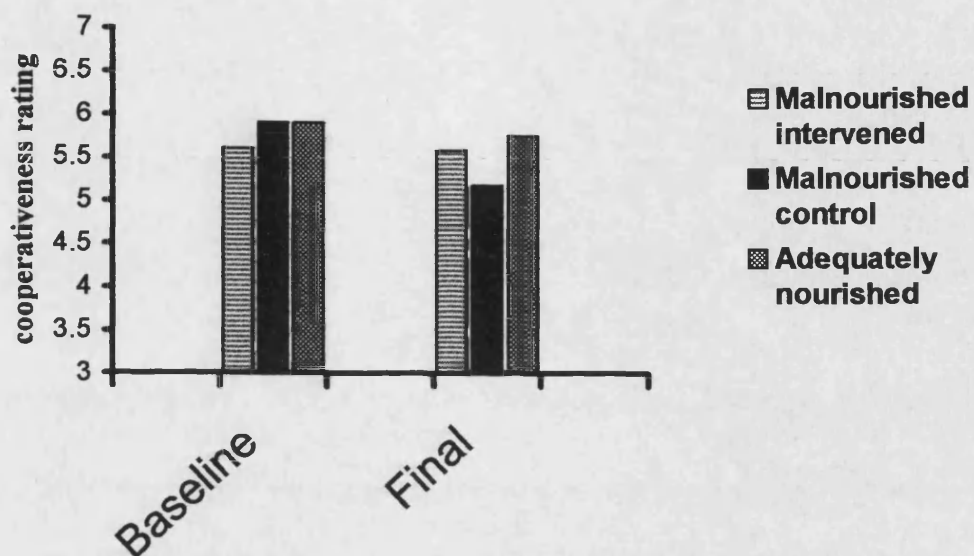
**Figure 4.8. Approach in the 3 groups at beginning and end of intervention**



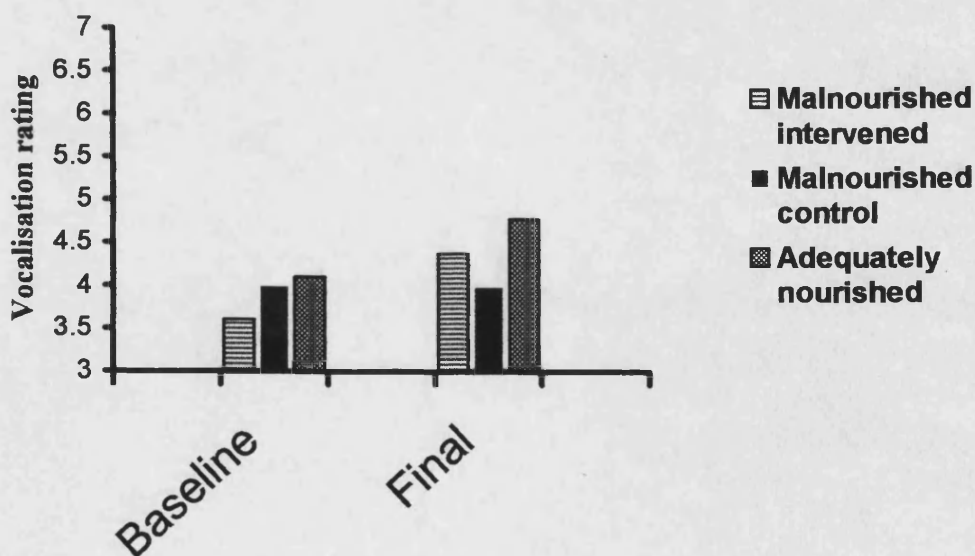
**Figure 4.9. Emotional Tone in the 3 groups at beginning and end of intervention**



**Figure 4.10. Cooperativeness in the 3 groups at beginning and end of intervention**



**Figure 4.11. Vocalization in the 3 groups at beginning and end of intervention**



## 4.5 EFFECT OF QUALITY OF INTERVENTION ON FINAL OUTCOMES

### *Nutritional supplementation and growth*

Attendance in the CNCs was not satisfactory in some of the cases and 14% and 5% in the intervention and control groups respectively attended less than 30 day whereas a minimum of 90 days was thought to be necessary. Thirty percent of the children in each of the two groups attended for more than 90 days and the rest attended between 31-90 days. The difference was not statistically significant between the two groups. The mean number of days (SD) that the children received supplementation was 70.4 (44.2) and 76.4 (42.5) in the intervened and control groups respectively. The difference was not statistically significant.

To examine if there was a relationship between number of days of supplementation and initial nutritional status we computed correlations between the days of supplementation and weight-for-height and height-for-age at enrolment. Days of supplementation correlated significantly with the weight-for-height z score on enrolment ( $r=0.23$ ,  $p=0.001$ ). Therefore the children who were initially more wasted received fewer supplements. There was no significant association between attendance and height-for-age.

We then conducted similar multiple regression analyses to determine if the number of days of supplementation had any relationship to growth. Supplementation was related to growth in weight ( $B=-0.002$ ,  $se=0.001$ , 95% CI= $-0.004, 0.000$   $p=0.03$ ), head circumference ( $B=-0.003$ ,  $se=0.001$ , 95% CI= $-0.006, 0.000$   $p=0.02$ ) and MUAC ( $B=-0.004$ ,  $se=0.001$ , 95% CI= $-0.006, -0.001$   $p=0.004$ ). The relationship with weight-for-height approached significance ( $B=-0.002$ ,  $se=0.001$ , 95% CI= $-0.004, 0.000$   $p=0.055$ ). In each case more supplement was given to the children with the poorest growth. There was no relationship between supplementation and growth in height of the children.

### *Psychosocial intervention*

In the intervention group the children were visited at their homes between 43-83 times during the year of intervention. Ten percent of the children were visited less than 56 times, 42% between 56-70 times and 48% had more than 70 visits over the

study period. Mean (SD) number of visits was 68.33 (8.7). Number of visits was correlated with final PDI ( $r=0.26$ ,  $p=0.01$ ) but not with MDI or other behavioural ratings.

We then looked at the number of group meetings that were attended by each mother. On average there were between 28 and 39 group meetings held by the PLs in the 10 villages. The mean (SD) number of meetings held was 33.6 (3.6). Twenty five percent of the mothers attended more than 30 meetings and 43% attended between 20-30 meetings. The rest (32%) attended less than 20 meetings. The mean (SD) number of group sessions attended by mothers was 23.3 (9.3). Their attendance was not correlated with the developmental outcomes.

Finally we examined whether the quality of the play leaders' performance, which was rated by the supervisors during their visits, was related to the intervened children's development. The mean of total ratings for each PL was calculated and the correlation with the MDI and PDI were calculated. It was significantly correlated to MDI ( $r=0.35$ ,  $p=0.001$ ) but not to PDI.

We then conducted multiple regression analysis with the intervened children only to determine if the number of home visits, number of group sessions attended by mothers and the quality of PLs had any effect on the change in developmental variables over the study period. In the regression model predicting MDI or PDI we entered the baseline measurement in the first step, offered age and mothers' education and knowledge of health and hygiene which were correlated to developmental indices in the second step and entered number of visits, number of group meetings attended by mothers and the quality of PLs in third step. The number of visits was positively related to PDI ( $B=0.6$ ,  $se=0.2$ , 95% CI=0.25,0.9,  $p=0.001$ ) whereas the number of group sessions negatively related to PDI ( $B=-0.36$ ,  $se=0.16$ , 95% CI=-0.7,-0.04,  $p=0.03$ ). PDI was not affected by the quality of performance of the PLs. MDI was not related to the number of group meetings or home visits but was positively related to the quality of performance of PLs ( $B=0.5$ ,  $se=0.2$ , 95% CI=0.17,0.9,  $p=0.004$ ) (Table 4.28.).

**Table 4.28.**  
**Significant regression coefficients (B), standard errors (se),**  
**and 95% confidence intervals (95%CI) from regression of MDI and PDI for the**  
**effect of the quality of intervention in the intervened children (n=92)**

Variables	MDI		PDI	
	B (se, 95%CI)	p-value	B (se, 95%CI)	p-value
Baseline scores	0.4 (0.1, 0.2,0.6)	<0.001	0.5 (0.08,0.4, 0.7)	<0.001
Age (months)	1.4 (0.3, 0.8, 2.1)	<0.001	---	---
Number of home visits	-0.07 (0.2, -0.41,0.2)	0.6	0.6 (0.2, 0.25,0.9)	0.001
Number of group sessions attended by mothers	0.08 (0.2, -0.2,0.4)	0.6	-0.36 (0.16, -0.7,-0.04)	0.03
Quality of Play Leaders	0.5 (0.18, 0.17, 0.9)	0.005	0.06 (0.2, -0.4,0.5)	0.8
R <sup>2</sup>	0.28		0.36	

Model:

Step 1. Baseline measurements entered. Step 2. Age, mothers' knowledge of health and hygiene and mothers' education offered. Step 3. Number of home visits, number of group sessions attended by mothers, and quality of Play Leaders entered.

## **CHAPTER 5**

### **DISCUSSION**

This chapter contains the following sections:

- A brief summary of the findings from the study
- Discussion of the validity of the study
- Discussion of the findings of the study
  - Intervention effect on growth
  - The relationship between nutritional status and development
  - Intervention effect on development and behaviour
- Discussion on the intervention
- Discussion on policy implications
- A description of the future plans and research questions raised by this study
- Conclusion from the study



### **5.1. SUMMARY OF THE FINDINGS**

The intervention significantly benefited the malnourished children's mental development index (MDI) and behaviour during the test. The intervened children approached the tester more readily at the beginning of the test and were more cooperative with her and vocalised more often throughout the test. The benefits to PDI were not statistically significant but the treatment effect approached significance ( $p=0.06$ ) when the children's nutritional status was taken into account. Treatment also improved mothers' knowledge of child rearing.

There was no general improvement in nutritional status during the study in either malnourished group and treatment had no effect on nutritional status.

Compared with the adequately nourished children, both the malnourished groups initially had significantly worse motor development and poorer socio-economic backgrounds. However the deficit in motor development remained when socio-economic background was controlled. There was no significant difference in their MDIs or behaviour ratings. However, the groups were selected by weight-for-age criteria that was used for enrolment of malnourished children to the CNCs and when all groups were combined, the association between PDI or MDI and height-for-age was highly significant.

Following intervention the intervened malnourished children remained similar to the adequately nourished children in their MDI and behaviour ratings but failed to catch up in PDI. In contrast, the control malnourished children not only remained behind the adequately nourished children in PDI but also fell significantly behind them in MDI and were different in 4 of the behavioural ratings. They approached the tester less readily at the beginning of the test and throughout the test they were less cooperative with the procedure and less happy and vocal.

The number of visits and the quality of play leaders were positively associated with benefits in the intervened children, whereas the number of group meetings was negatively associated with benefits.

## 5.2. VALIDITY OF STUDY

Before discussing the findings I will first consider to what extent they are valid. The following discussions about validity of the study are based on the suggestions made by Cook and Campbell (Cook and Campbell 1979), who identified several types of validity.

The first type of validity is the statistical conclusion validity. This refers to the level of confidence with which the results can be accepted and depends to a large extent on the power of the study. The ability to identify a significant difference when there is a difference is the power of a study. There is a risk of having type II error that means getting false negative finding if the statistical power of the study is low. In this study the power was initially calculated to be 90% to detect a mean difference of 6 points in MDI with a standard deviation of 12 (the standard deviation was based on a Jamaican study but was also previously found in Bangladeshi children). The loss was calculated to be 15%. Although the loss was extremely small, the standard deviation for MDI found in this study was 14.7, which was larger than we had anticipated. Therefore the power of the study was just less than 80% with the number of children who completed the study. However, we got a significant benefit in MDI, behavioural ratings, and mothers' knowledge of child rearing in favour of the intervention. It is likely that the effects on PDI would have been significant if the study had more power. As it was, the effect of intervention was nearly significant after controlling for nutritional status.

In this study multiple regression analyses were used to measure the effects of treatment in the intervention study and initial scores on the outcome measures were controlled. We also used multiple regression analyses to examine the differences between malnourished and adequately nourished subjects, and this allowed us to control for other SES differences between the groups. Multiple regression is a powerful statistical test for such measurements and we only accepted significance levels below 5%.

The other threat to this type of validity is when the non-parametric distribution of the sample is not adequately dealt with. In our sample all but 2 of the variables

were normally distributed. We were able to achieve normality by transforming those variables.

Measurements should be reliable for the study to be able to detect differences. The Bayley test has good test-retest reliability in this population. Three testers conducted the developmental tests and there was good agreement among three of them before and during the study.

The settings in which developmental tests were conducted were the laboratory setting and it may have affected the children's performance due to strangeness of the place and seeing new people. The behaviour ratings were on a 9-point scale from 1-9 and the children were scored for their response to the examiner during the first 10 minutes and across the groups the mean was 6.2 with a SD of 1.3. Their emotional tone and cooperation showed a mean of 5.6 and 5.8 and SD of 1.5 and 1.6 respectively. Means of 6.2, 5.6 and 5.8 suggest that the average child was reasonably happy and cooperative in the test and did not appear too upset by the test situation.

Anthropometrists were also trained extensively and good inter-observer reliability was obtained both before and during the measurements.

Reliability of treatment implementation is also important. Our intervention involved home visits and group sessions in the nutrition centres. The delivery of the intervention was reasonably standardised and constant, however, it is very difficult to provide absolutely comparable intervention with 10 PLs working in 10 different villages. To minimise the differences two additional supervisors apart from the investigators were recruited who scored the PLs performance at each supervisory visit. The scoring was between 3 and 16 points. The mean score for the PLs' performance was 10.7 and the range was from 9.5 to 11.6. We trained the PLs extensively both before and during the study. However individual differences in delivering the messages were still present as demonstrated by the effect of the PLs' quality of performance on MDI (Table 4.28.).

There was also some variation in the number of visits that the children received by the PLs. These were not associated with change in MDI but were associated with change in PDI and entered the equation in the multiple regression model of PDI ( $B=0.6$ ,  $SE=0.2$ ,  $p=0.001$ ,  $95\% CI=0.25,0.9$ ).

Internal validity of a study refers to whether the inference of causality of the findings is justified. The intervention had a robust design with random assignment of the CNCs to treatment groups with pre and post measures. The groups were similar in all characteristics initially except paternal education and this was controlled for in the regression. However the randomisation took place at the level of the villages in which they lived.

Appreciating a threat to the internal validity we conducted multilevel analyses to control for the variance among the villages, and all treatment effects remained significant. There was no true placebo although the control children received a few visits, therefore, it is not certain whether it was just visiting the homes or following the curriculum of activities that produced the benefits.

Loss of subjects is another threat to the internal validity of the study. In our study the loss was 3.5%, which is negligible, and the difference between the lost and tested subjects were neither significant nor correlated to the outcome variables.

Familiarity with test may also be counted as a threat to the internal validity. If the children are tested frequently on the same test they may develop familiarity with the test and do better at the later tests. All the children in this study were tested twice with a gap of one year between the two tests. The items used after one year mostly differed from those used the year before as the children's age was increased by one year. It is also less likely that the children remember the test or the testers after a period of one year. One fourth of the children were tested an extra time after eight months and to avoid a familiarity bias in any of the groups we randomly selected the same number of subjects from all the 3 groups. The selection of children from all the groups should remove any bias in testing familiarity.

Diffusion of treatment occurs when the control group, which is not assigned to the treatment, receives it. This was also minimised in our study because control and intervention children came from different villages. However since all the villages were in the same district, it remains possible that some of the inhabitants may have visited each other. We tried to make sure that this did not happen by asking our local staff to report if any of the children in the intervention villages had any relative in the control villages. To our knowledge none of them had any relative in any control village.

Compensatory rivalry or resentful demoralisation is said to occur when the control group who did not receive the treatment wants to compensate by trying hard to obtain better scores or trying less as a result of demoralisation. This threat to validity is obviously not relevant to children of ages between 18-36 months. Since mothers of the control group did not mix with those of the intervention group, it is also unlikely that they would have been affected by the study or influence their children to try more or less hard.

Compensatory equalisation of treatments may occur if the group or subject who was not assigned to the treatment is offered it. This occurs when the researchers decide to offer the more beneficial treatment to all the subjects but we are unaware of any control children receiving the psychosocial intervention till the end of the study.

Construct validity is said to be present if the dependent and independent variables are well defined and measure what they are meant to. In addition it is acceptable when the processes that bring about the empirical findings are the same as those, which were initially hypothesised. The intervention had a detailed curriculum that clearly focussed on improving the cognitive and language development of the children and regular supervision ensured it was delivered as intended.

In this study Bayley tests were performed to measure the development of the children at pre and post-tests. There are some validity problems with using tests not standardised or developed in the population and these constraints are discussed in the chapter-3 on 'Methods'. In the present study the mean Bayley scores were

within the normal range and scores were related to stimulation in the home, maternal education and child nutritional status in a theoretically sensible way but we had no other measure of development to check validity. The predictive validity in this population is unknown. However, initial scores were significantly related to final scores one year later in both MDI ( $r=0.31$ ,  $p<0.001$ ) and PDI ( $r=0.36$ ,  $p<0.001$ ) after controlling for the age of the children.

External validity is the extent to which the findings of a study can be generalised to other populations, other settings and in other times. The study was conducted among the rural children in Bangladesh. The recruitment included all the moderately and severely malnourished children attending the CNCs to receive food supplementation in each of the 20 villages and matched adequately nourished children in the same villages. There was no refusal at the beginning of the study but three families refused to participate in the middle of the study. The loss was only 3.5% (11 subjects) and therefore it is likely that the sample was a representative sample of the population examined. The results of the study can probably be extrapolated to other rural Bangladeshi children of the similar age group and SES. However it may not be possible to extrapolate the findings to urban Bangladeshi children or to children in other parts of the world.

The intervention was given to children between the ages of 6-24 months and it is not possible to conclude that the intervention would have had a similar result in children younger or older than the present subjects. The study would need to be replicated in other age groups to assess the effects of intervention in those children.

### **5.3. DISCUSSION OF FINDINGS**

#### *Intervention effect on growth*

The intervened and control malnourished children did not show any improvement in growth in any of the measurements. There is some debate as to whether it is possible for stunted children to catch up in height. Golden believes that if the appropriate diet is supplemented over a sufficient time complete catch up occurs (Golden 1994). Catch up growth is attained either through prolongation of the period of growth or acceleration of growth rate and the latter occurs more effectively in the younger age group. However, children who return to the settings

in which they became malnourished are unlikely to experience full catch up (Martorell et al. 1994).

Most other nutritional supplementation studies have shown some positive results on growth, though some were disappointing. In Bogota (Mora et al. 1981) and Guatemala (Klein et al. 1976) increases in linear growth were small, rarely amounting to more than a centimetre per year. In Jamaica, supplementation benefited stunted children's weight and height at the end of the study but the supplement was taken to the homes weekly (Grantham-McGregor et al. 1991). Younger children benefited more from supplementation, but these gains disappeared by 11-12 years (Walker et al. 2000). In Cali, Columbia height and weight increased in a dose response manner, but that was a centre-based intervention (McKay et al. 1978). Furthermore, at 10 years of age, 3 years after the termination of intervention, effects on growth were no longer evident (Prez-Escamilla and Pollitt 1995). A short-term nutritional supplementation study in Indonesia (Husaini et al. 1991) supplemented undernourished children of similar age to those in our study for 90 days. The children in the supplemented group experienced significant gains in weight at the end of supplementation but not in length (Fig. 5.1).

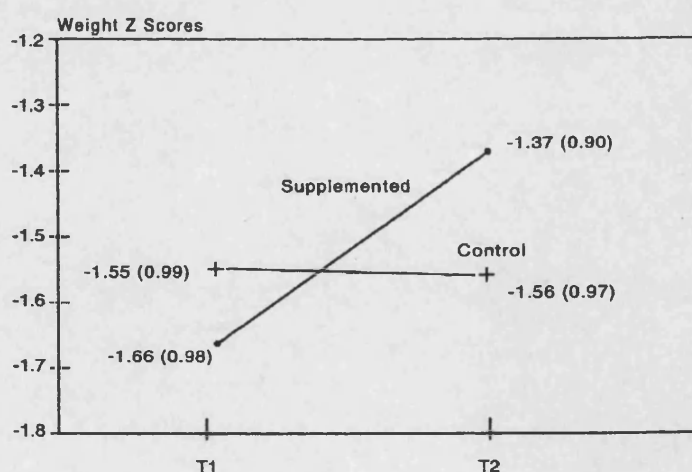


Figure 5.1. Weight z scores: Mean (SD) before (T1) and after (T2) treatment.  
Husaini et al. 1991

Another Indonesian study that supplemented the children for 12 months showed benefits of supplementation on the children's weight and MUAC in both the 12 and 18 month old cohorts. They also showed benefits on the growth of the head circumference of the children who entered the programme at 12 months of age (Beckett et al. 2000).

The lack of any effect of supplement in the present study is therefore disappointing and should have an explanation. There are several possible explanations, which include insufficient supplement, lack of compliance, poor quality supplement, and infections and these are discussed below.

#### Reasons for lack of catch-up in growth

##### a) Insufficient supplement

The children in the malnourished group had very poor nutritional status at enrolment. They were admitted to CNCs for the treatment of malnutrition and it was expected that they would improve by the end of the 90 days of supplementation. However the study showed that there was no significant change in the nutritional status of the malnourished children even at the end of the study one year after enrolment. The supplement provided only 150 and 300 Kcal/ day for the moderately and severely malnourished children respectively. According to the recent guideline by WHO (WHO 1999b) the treatment of malnourished children should include a total calorie intake of 100 Kcal/kg/day. The weight of the malnourished children in our study ranged from 4-10 kg on enrolment and the mean was 7.3 kg. This means that they needed an amount of 400-1000 Kcal/day and the amount provided in the CNCs was much lower than their daily requirement. However the given amount is supposed to be a supplement and not a substitute to their diet. The mothers were encouraged to feed their children with usual family diet in addition to the supplement.

We did not keep an account of the children's daily dietary intake but in a study that evaluated the services of BINP it was found that in 28% of the cases the supplement was substituted for at least part of their domestic food intake (Abdullah et al. 2000).



## **b) Compliance**

Compliance is an important factor in supplementation studies and most long-term supplementation programmes face compliance problems. Poor compliance may be due to a variety of reasons, for example there were difficulties faced by some parents in collecting the supplements. Some families lived at long distance from the CNCs and had to walk for a long time to reach there. Some mothers were overburdened with household work and may not have had time to go and collect the packets. Timing of the visits may not have been convenient, for example mothers were advised to visit CNCs in the morning between 8-11 AM. This is an extremely busy time for mothers who have to cook, clean, and manage all the household chores at home before lunchtime. Another problem in achieving full compliance is the relationship between the mother and the CNP who provides the supplements. A warm empathic CNP would gain mother's confidence and ensure full participation in the programme. In this regard training off the CNPs is of utmost importance. Unfortunately we did not have resources to assess the relationship between the CNP and individual mothers. In general the programme demanded considerable effort on the mothers' behalf for relatively little supplement.

In contrast to the present study the studies from other countries described above made it easier for the mothers to obtain the supplement. In the centre based supplementation studies referred to above in Indonesia (Husaini et al. 1991; Beckett et al. 2000) and Cali (McKay et al. 1978) the children were already attending the centres for play activities and day care. Whereas in the home-based supplementation studies referred to above either the supplement was delivered to the homes (Grantham-McGregor et al. 1991) or the parents were required to visit a centre once a week to collect the supplement (Mora et al. 1981). The Guatemalan study (Klein et al. 1976) was an exception in that children had to be taken to the centres daily to be fed there but the centres were larger and the mothers congregated and socialised. In addition, the children were encouraged to eat as much as they wanted and they had to eat it in the centre so that sharing could not take place.

It is also possible that the parents of the malnourished children were not interested. Their lack of knowledge about the importance of supplementation may have been another threat to the success of the programme. They may not have been informed and fully convinced that their child suffered from malnutrition and required treatment.

We did not measure the actual amount eaten by the child as we did not have a full control over the programme and we also lacked sufficient resources. We therefore do not know if the children were fed the supplement or if it was shared with other children or other members in the family. Although the children were supposed to eat the supplement in the centre this frequently did not happen. Sometimes the mothers sent another older child to collect the packets and at times when the child was brought to the CNCs to collect the packet, it was not fed to the child in presence of the CNPs.

Poor compliance may therefore be a cause of finding no improvement in the children's growth. In a study that assessed BINP centres in two villages it was observed that 31% of the eligible malnourished children were irregular in their attendance to CNCs and 15% did not participate at all (Rahman and Islam 2000). In our study attendance was better and only 14% and 5% in the intervention and control groups respectively attended less than 30 days out of the required 90 days. In our study supplementation was significantly related to growth in weight, head circumference and MUAC and its relationship to weight-for-height approached significance. In all the cases more supplement was offered to the children with poorer growth and it may be concluded that the treatment was given to the most needy children.

### c) Quality of supplement

Another possible cause for the failure of the children to improve in nutritional status is that these malnourished children were likely to be deficient not only in calories and protein but also in many micronutrients (Schurch 1995). Unfortunately additional micronutrients were not provided in their diet. Iodine, iron, folic acid, zinc, calcium, magnesium, selenium, potassium, copper, and vitamins are

recommended by WHO to be given during rehabilitation of malnourished children (WHO 1999b). Bioavailability of the micronutrients is another important issue. The absorption and utilisation of the micronutrients depends on the nutritional condition of the infants, the maturity of their gastrointestinal tract and the consumption of other types of food such as phytate and oxalic acid which reduce absorption of some micronutrients (Krebs 2001). Micronutrients are needed for growth and play a role in cellular and humoral immunity and many micronutrients are known to be required for the production of many enzymes. Deficiency of micronutrients therefore, leads to impaired immunity, which in turn traps the child in a vicious cycle of infection and malnutrition (Guerrant et al. 2000). The lack of micronutrient in the supplement could explain the failure of the children to catch up in growth.

#### **d) Infection, Immunity**

Unfortunately we did not measure morbidity but malnourished children are known to have impaired immune response. Cell-mediated immunity, cytokine production, phagocyte function, response to secretory antibody, and the complement system are all affected in malnutrition (Chandra 2002). Chandra claims malnutrition is the commonest cause of immunodeficiency in the world.

Infections are usually very common in malnourished children and are another cause of not gaining adequate weight. Infection causes reduced intake due to anorexia and reduced absorption but increases the requirements for energy for the inflammatory response muscle protein catabolism, and increased loss such as in diarrhoea (Keusch 1990). The interaction between nutrition and infection causes a further delay in growth of the child and a vicious cycle is produced. In our study we treated any apparent infection with antibiotics, but according to the guidelines of WHO the severely malnourished children must be treated with empirical antibiotics (WHO 1999b). Unfortunately we did not have sufficient means to follow these guidelines and it may be that they suffered from covert infections, which were not diagnosed due to their reduced immunity and inability to show an immune response. Infection and malnutrition usually occur sequentially and form a vicious cycle. Unless the cycle is broken at some point the malnourished children continue to suffer from different infectious diseases and these infections cause

them to be more malnourished and prone to more infections.

e) No control group for supplementation

Finally in our study there was no control group for supplementation and all the malnourished children received supplements. Therefore it was not possible to identify the effects of supplementation on the growth of the children with certainty. The supplementation may have benefited the children by preventing further deterioration in their nutritional status or reducing morbidity.

*Conclusion*

In conclusion our results on growth appear poorer than the results of some other studies in which malnourished children were supplemented but there are several reasons for this. The most important difference between the supplementation studies cited above and the present one is probably that in this study the supplement was part of an ongoing programme and was not under the researchers control. In contrast, in the other studies the administration of supplement was specially set up for the study and under control of the researchers. The present programme required considerable effort from the families and provided only small amounts of poor quality supplement. However, there was no control group not receiving supplementation and it remains possible that the supplementation prevented further deterioration in nutritional status.

*The relationship between nutritional status and development*

We had hypothesised a significant difference in the development and behaviour between the malnourished and adequately nourished children. On enrolment a deficit was found in MDI and PDI but when we controlled for socio-economic differences, it only persisted in PDI. The groups were chosen on the basis of weight-for-age because it is the nutritional index used in the centres, however, it is a mixture of stunting and wasting and child development is more often related to stunting than wasting (Grantham-McGregor et al. 1999). When all groups were pooled there was a significant association between height-for-age and both MDI and PDI after controlling for social background. However, the effect size of height-for-age on PDI was double that of MDI. Several studies of infants and toddlers

have shown that motor development is affected earlier by nutrition than mental development (Waber et al. 1981; Joos et al. 1983; Husaini et al. 1991). Many studies have found association between stunting in early childhood and poor concurrent and long term cognitive and motor development (Grantham-McGregor 2002).

To our surprise there was no significant difference in any of the behavioural ratings between the malnourished and adequately nourished children on enrolment. The groups were not as different as we had originally planned as there were insufficient children with weight-for-age better than -1 z scores to form the adequately nourished group. We therefore had to enrol children with weight-for-age better than -2 z scores and this may have reduced the difference between groups. It is also possible that the ratings were not sufficiently sensitive. However at the end of the study the control malnourished children who had not received any stimulation were significantly behind the adequately nourished children in both mental and motor development as well as in 4 out of 5 behavioural ratings. The adequately nourished children showed higher scores of approach, emotional tone, cooperation and vocalisation than the control malnourished children who were more inhibited, less cooperative, less vocal and fussier. This type of behaviour has often been found before in undernourished children for example, stunted children in Egypt, Mexico and Kenya smiled less and cried more often than the better nourished ones (Allen 1993). Further examples are given in the introduction (Chapter 1.5).

### *Intervention effect on development and behaviour*

#### Mental and motor development

The children in the intervention group benefited on mental development index by 5 points. This was a third of a standard deviation of the population examined and probably of clinical importance. However, the size of the benefit was a little disappointing, as we had hoped for larger improvements.

The children's improvement was considerably less than what was reported in three previous Jamaican studies (Grantham-McGregor et al. 1983; Grantham-McGregor et al. 1991; Powell and Grantham-McGregor 1989). The first study involved hospitalised severely malnourished children who gained 14 DQ points (one SD) more than the non-intervened malnourished children after one year of psychosocial

stimulation (Grantham-McGregor et al. 1983). This study with severely malnourished children was unique in that the hospital stay provided an initial opportunity for intense stimulation for around 6-8 weeks and the intervention staff did most of the play in hospital. This was followed by weekly home visits. Also mothers were probably frightened by the child's illness and therefore may have been more motivated to participate.

However, another Jamaican study (Grantham-McGregor et al. 1991) used a similar approach of weekly visiting and the children were stunted but they were in the community and were not severely ill. The intervened children gained 9 DQ points (two thirds of an SD) more than the non-intervened children after one year of psychosocial stimulation. A third study involved deprived but adequately nourished Jamaican children (Powell and Grantham-McGregor 1989) and used a similar approach of weekly visiting and the children gained 11 DQ points almost one SD after one year of intervention.

Possible reasons for the poor response will be discussed in the next section on "intervention".

Although there was a trend for increased scores in PDI in the intervened group, it did not reach significant levels. When we controlled for nutritional status the effect of treatment on PDI increased and approached significant levels ( $p=0.06$ ). It is possible that continuing poor nutritional status have been responsible for the relatively small improvement in motor development. In addition, previous stimulation studies have shown that stimulation mainly affects cognition and school achievement (McKay et al. 1978; Grantham-McGregor et al. 1994; Black et al. 1995; Walker et al. 2000) and that motor development is least affected by stimulation.

In the present study, after intervention the malnourished children were not different from the adequately nourished group in mental development but were poorer in motor development. To our knowledge, only three studies of stimulation with undernourished children had an adequately nourished control group. These were two Jamaican studies (Walker et al. 2000; Grantham-McGregor et al. 1987) and a study in Cali Colombia (McKay et al. 1978).

In one Jamaican study (Grantham-McGregor et al. 1991) intervened stunted children who received either stimulation or supplementation did not catch up with the non-stunted group in their development but the group that received both supplementation and stimulation caught up by the end of intervention

In the other Jamaican study (Grantham-McGregor et al. 1983) severely malnourished children began intervention in the hospital and continued at home. They caught up with the adequately nourished children after two years in every subscale of the Griffiths test except the Locomotor one which measures motor development.

However, in both these Jamaican studies the benefits declined somewhat at follow-up when the intervened children were below the adequately nourished children, although still better than the non-intervened malnourished children (Grantham-McGregor et al. 1987; Walker et al. 2000).

The study in Cali Columbia (McKay et al. 1978), included a comparison group of children from poor families with normal weight and height but they were only tested at the beginning and end of the study and not as often as the other groups were tested. The results showed that the intervened undernourished children had higher scores than the adequately nourished comparisons from the similar socio-economic background by the end of the study.

It would seem that stimulation can reduce the deficit in mental development in undernourished children at least concurrently. It may be that stimulation compensates for the reduced exploration found in malnourished children. Improvement in motor development is less likely unless nutritional status improves.

### Behaviour

It was very encouraging that four behaviour ratings also improved. The intervened children were significantly less inhibited, happier, more cooperative and vocalised

more often than the control malnourished children. These were the same behaviours in which control malnourished children differed from the adequately nourished children.

As discussed in the introduction (Chapter 1.5. review of the literature on malnutrition and behaviour) malnourished children are usually less exploring due to lethargy, apathy, and being less interested in their environment (Grantham-McGregor 1995). This behaviour is known as "functional isolation" as the children isolate themselves from the environment and therefore get less chance of developing their skills (Levitsky 1979). Improving their behaviour should therefore, facilitate further improvement of cognition. The change in behaviour following psychosocial intervention has not been looked at in other studies with moderately undernourished children. However, behaviour was examined in the study with severely malnourished children in Jamaica three years after intervention (Grantham-McGregor et al. 1989b). The non-intervened malnourished children played for shorter periods and stayed closer to their mothers than the intervened malnourished children who were similar to the adequately nourished control group. Thus it appears that stimulation intervention can remove the behavioural deficits associated with malnutrition.

#### **5.4. INTERVENTION**

We attempted to visit the children twice a week, which was more frequent than any Jamaican study and we were concerned that this may have been too intrusive for the mothers' busy schedule. However it is unlikely that they were intrusive as some children received more frequent visits than others and those receiving more visits improved the most in PDI although not in MDI. It is possible that if all visits had been done the children's PDI may have improved further, but difficulty in communication in rural areas and political unrest made it difficult to do more visits. However, the close relationship to the frequency of visits hints that the PLs' time playing with the child may be a critical factor. However, the close relationship to the frequency of visits hints that the visitors' time playing with the child may be a critical factor. The intention was that the mothers' time playing with the child would be the most important part of the intervention. The mothers may have thought that it was the PLs' role to play with the children rather than their own and



therefore did not play with the child as much as they should have played. If true, this could be a weakness and needs investigating.

Whereas home visits were the important component in the programme, group meetings attended by mothers had small but significantly negative effect on PDI once home visits were controlled. It may be that mothers who wanted to get away from their homes were the ones who attended most and attendance at meetings was a marker for having more troubled environment at home.

It is of course possible that other unmeasured benefits accrued to the mothers from the meetings such as improved self-esteem and less depression. Certainly the mothers appeared to enjoy the meetings

#### *Expense of programme*

This was a research project and the inputs were considerable. We hired a play leader for each village and more than one supervisor. We did this intentionally as there was no previous experience of similar programmes in Bangladesh and we needed to document it carefully. If the programme is to be successfully spread we not only need to examine ways of making it more effective but we also need to reduce the costs. It would be possible to train existing BINP staff to do the visits and we need to explore visiting less frequently. A very recent study in Jamaica has shown that a visit every 10 days was successful (Powell et al. 2004).

#### *Quality of PLs*

It may be that our PLs were not as competent as those used elsewhere. Our PLs were shy and culturally inhibited which made it difficult for them to relate, as they should, to the mothers. Since most of them were young and half were unmarried, they may have had less credibility among the mothers. We tried to overcome their shyness problem by having regular meetings and training workshops for them. We could not do anything about the younger age of the PLs as we required a minimum educational qualification of 10 years of schooling and we couldn't find such levels of education among the older and married women. We tried to find out if the differences in the quality of the PLs were related to any individual characteristics among them. Their ages did not differ and all were young. All of them had similar

educational background and came from more or less similar socio-economic status. There was no difference between those who were married and those unmarried, neither was there any difference among those who were already mothers and those who were not. We did not have any other information regarding their IQ or personal-social abilities. This may have been an important factor accounting for such differences in delivering the intervention. In future studies it may be useful to examine the effectiveness of both less educated but older more experienced women and more educated ones with higher IQ and more capabilities.

### *Cultural influences*

Bangladesh is a Muslim country and women are not encouraged to talk or participate in discussions among other family members. They do not go out of the home except on rare occasions for special purposes and therefore lack social abilities to interact with others. Mothers were therefore, culturally inhibited and they even thought it was rude if they asked something that they didn't understand. Some of them did not participate in the discussions during the meetings. This may explain the negative effect of the group meetings on PDI.

It may have helped to include the grandparents and fathers more, as the status of young women in the household tends to be inferior. We had hoped to boost their self-esteem but unfortunately did not measure it. It is also likely that play is not a priority for such poor communities. The focus group discussions confirmed this and we need to emphasise more on how play can bring tangible benefits.

## **5.5. POLICY IMPLICATIONS**

Prevention of malnutrition is always more important and more cost-effective than its treatment. Therefore programmes to prevent malnutrition are of primary importance. However, in a country like Bangladesh where stunting and wasting is so prevalent and affects 55% and 18% of children respectively, the need for improving children's nutritional status is of utmost importance. Obviously the quantity and quality of the supplementation was not adequate to improve the children's growth and therefore more attention should be paid to improving the quality of the food like adding micronutrients and increasing the amount given to the children. It would also be useful to explore other ways of distributing the

supplement such as giving a week's supply at one time.

Since these wasted and stunted children are already at the risk of having poorer psychosocial development the integration of child development activities with the treatment of malnourished children may be an effective means of improving their overall development. The BINP nutrition centres give us an enormous opportunity to introduce child development activities into the treatment of malnourished children in order to promote their all round development. As previously stated the long-term aim of the project is to spread the programme to all CNCs. For this purpose a link should be set up with the government of Bangladesh and its policy makers to disseminate the programme to all the community nutrition centres in the country. BINP programme is going through a transition and has changed to National Nutrition Programme (NNP) with slightly different goals and objectives. The government has already planned to start early childhood development programmes in the country. UNICEF along with the Institute of Child and Mother Health (ICMH), which is a national institute, Bangladesh Rural Advancement Committee (BRAC) and Grameen Shikkha, which are NGOs, are working with the government of Bangladesh to implement the programme using the infrastructure of BINP. Our research group is in close contact with UNICEF and ICMH staff and they have asked us to participate in the evaluation of the programme.

The need for improving the quality and increasing the amount of the supplement should also be discussed.

## **5.6. FUTURE RESEARCH**

Future research should focus on exploring modifications of the approach used here to determine the most effective means of improving the development and growth of malnourished children in this culture.

Research questions that need be asked are:

- What should be the amount of supplementation to ensure full catch up in the malnourished children?
- Does adding micronutrients to the supplement affect growth, development and behaviour of the malnourished children?

- Can we establish stimulation in the CNCs without hiring extra staff but by training current BINP staff?
- How can we make the stimulation curriculum more culturally relevant?
- What are the benefits if we work with grandmothers and fathers?
- How much do the mothers in the programme play with their children?
- Why were the group meetings not successful?
- Is it necessary to use so many toys in the programme?
- What is the optimum duration of psychosocial stimulation for maximum developmental benefit in malnourished children?
- What is the effect of home visits alone, and what frequency produces the most benefits?
- Do mothers benefit from such programmes in terms of improving their self-esteem, reducing their depression and increasing their autonomy in household affairs?

#### *Research already in progress*

We have started a new project similar to the present one which looks at the effects of psychosocial stimulation and parental counselling on mental development and behaviour of severely malnourished children attending nutrition and rehabilitation unit of Dhaka hospital at ICDDR,B. We have modified the curriculum to emphasise more maternal-child verbal interaction during care taking activities such as bathing, feeding, and dressing and during household work. We are also making more effort to get the mothers to participate by deliberate strategies such as listening to them and getting them to suggest activities and play materials. We are also involving other family members more.

I'm also a co-investigator in another large project that examines the effects of food and micronutrient supplementation in pregnant mothers on children's development and behaviour.

We are also planning to look at the effect of giving undernourished children micronutrients combined with stimulation.

## **5.7. CONCLUSION**

It is clear that malnourished children develop poorly compared with adequately nourished children. This study shows that it is feasible to integrate child development activities into the nutrition services in Bangladesh and it is possible to improve the development of malnourished children. Therefore, supported by data from other similar studies (Walker et al. 2000; Grantham-McGregor et al. 1994) we can safely conclude that the psychosocial stimulation of the malnourished children is an effective means of improving their development and behaviour and that it needs to be added to their nutritional rehabilitation. However future research is needed in Bangladesh to determine ways of improving the stimulation programme to be more effective and less expensive. Also there is an urgent need to review the quality and quantity of the supplements given in the BINIP programme, as the children in our study did not show improvement in their nutritional status.

## **CHAPTER 6**

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## **CHAPTER 7**

### **APPENDICES**

#### **7.1. BEHAVIOUR RATINGS**

##### *Approach (Initial response to the examiner)*

The examiner addresses a few introduction remarks to the child and then talks with the mother after giving the child a toy.

Response in the first 5 to 10 minutes is rated. It should be rated immediately, not at the end of the test.

1. Avoiding: shows stray signs of fear like clinging onto the mother/ fussing / looking away/ withdrawing.
2. Between 1 and 3.
3. Hesitant: some fear/ obviously worried/ wary and watchful/ not happy /not smiling/ not fussing/ not readily playing but there may be slight touching of toy. May look fleetingly at examiner.
4. Between 3 and 5.
5. Accepting: No sign of fear but aware of examiner/ not offering the toy/ not vocalising or smiling at examiner/ but looking at her from time to time without fear. Plays with toy but not with vigour.
6. Between 5 and 7.
7. Friendly: Not afraid. May smile or vocalise or offer toy to examiner after a few minutes, plays with the toy readily.
8. Between 7 and 9.
9. Inviting: Fully accepts examiner, happily Interacts with her smiling, vocalising and/or approaching. Obviously enjoys the toy, may show enthusiasm in playing.

##### *General Emotional Tone*

This scale refers to how unhappy and fussy or cheerful and happy the infant appeared throughout the examination and should be rated at the end of the test.

1. Child seems unhappy throughout assessment, gets very upset, cries and fusses for long periods or frequently may protest and wail.
2. Between 1 and 3.

3. At times rather unhappy begins to fuss with cries. Short verbal protest may be present but may respond happily to some procedures.
4. Between 3 and 5.
5. Moderately happy or contented (may smile once or twice and positively vocalise occasionally in response to some tasks), may become upset occasionally but recovers fairly easily.
6. Between 5 and 7.
7. Generally appears to be in a happy state of well-being. Smiles often with some excitement. Only becomes briefly unhappy once or twice during the whole assessment.
8. Between 7 and 9.
9. Radiates happiness, highly excited, nothing is upsetting (never becomes upset), animated, expressive, smiling, and gleeful.

#### *Activity*

This scale refers to how physically active the infant was during the testing (gross motor activities) and should be rated at the end of the test.

1. Very still, little gross motor movement. Stays quietly in one place, with practically no self-initiated movement, never wiggles around.
2. Between 1 and 3.
3. Usually quiet and inactive, rarely wiggles but responds appropriately in situations calling for some gross motor activities (motor task)
4. Between 3 and 5.
5. Moderate activity, wiggles occasionally and may get up or change position a number of times, can be quieted for sedentary tests without much difficulty.
6. Between 5 and 7.
7. In action during much of the assessment period, gets up frequently, moves around the room, wiggles, movements are consolable and can be quieted for sedentary tests, however with difficulties sometimes.
8. Between 7 and 9.
9. Overactive, on the move all the time, wiggles a lot, cannot be quieted for most of the sedentary tests.

### *Cooperation with test procedures*

This is a measure of how well the infant co-operates with the examiner and complies with her requests and should be rated at the end of the test.

1. Resists all suggestions or requests, which are assessment related, very resisting and uncooperative.
2. Between 1 and 3.
3. Refuses or resists several specific examinations initially or refuses to co-operate during part of the session (e.g. initially or towards the end).
4. Between 3 and 5.
5. Accepts the assessment or situation, neither cooperative nor resistant in relation to examiner, may occasionally say "No" but will conform.
6. Between 5 and 7.
7. Seems to enjoy the interaction with the examiner, is happy to participate most of the time.
8. Between 7 and 9.
9. Enjoys the session and always complies, readily accepts the examiner's manipulation.

### *Vocalisation*

Vocalisations refer to non-crying utterances or to recognisable utterances embedded in crying. These may be cooing, babbling, consonant sounds or words. Crying per se, no matter how varied, does not qualify. This behaviour should also be rated at the end of the test.

1. Definitely quiet, 1 or 2 vocalisations.
2. Between 1 and 3.
3. Few vocalisations and of short duration.
4. Between 3 and 5.
5. Vocalisations occur as part of the activities but too intermittent to constitute vocal excitement, chatter or the like.
6. Between 5 and 7.
7. Vocalisations constitute an obvious part of the infant's activity: infant vocalises for the sake of vocalising.
8. Between 7 and 9.
9. Excessive vocalisations, high vocal excitement.



## 7.2. DEMOGRAPHIC AND SES INFORMATION

Date /\_/\_/\_/\_/\_/\_/\_/\_

Name of the interviewer: \_\_\_\_\_

1. Study ID/\_/\_/\_/\_/\_/\_/\_/
2. Play Leader/Health Worker's name \_\_\_\_\_
3. Name of the child \_\_\_\_\_
4. Mother's name \_\_\_\_\_
5. Number of family members /\_/\_/\_/
6. Number of bed rooms /\_/\_/\_/
7. Roof condition 1= Straw, 2=Tin, 3=Cement, 4=Others /\_/\_/\_/
8. Wall of the house 1=Straw/Jute/Bamboo, 2=Earthen, 3=Wood, 4=Tin, 5=Cement, 6=Others /\_/\_/\_/
9. Source of drinking water: 1=River/Canal/Pond, 2=Well, 3=Tube well /\_/\_/\_/
10. Location of drinking water 1=Outside, 2=Within house compound /\_/\_/\_/
11. Electricity 1=No, 2=Yes /\_/\_/\_/
12. Latrine 1=No fixed place, 2= Open, 3=Semi-sanitary, 4=Sanitary /\_/\_/\_/
13. Number of beds /\_/\_/\_/\_/
14. Number of tables /\_/\_/\_/\_/
15. Number of chairs /\_/\_/\_/\_/
16. Number of show-case/Steel Almirah /\_/\_/\_/\_/
17. Do you have radio? 1=No, 2=Yes /\_/\_/\_/\_/
18. Do you have cassette player? 1=No, 2=Yes /\_/\_/\_/\_/
19. Do you have TV? 1=No, 2=Yes /\_/\_/\_/\_/
20. Do you have Fan? 1=No, 2=Yes /\_/\_/\_/\_/
21. Do you have Bicycle? 1=No, 2=Yes /\_/\_/\_/\_/
22. Do you have any other electric good? 1=No, 2=Yes /\_/\_/\_/\_/
23. Do you have wall clock/watch? 1=No, 2=Yes /\_/\_/\_/\_/
24. Do you have van? 1=No, 2=Yes /\_/\_/\_/\_/
25. Do you have rickshaw? 1=No, 2=Yes /\_/\_/\_/\_/
26. Do you have boat? 1=No, 2=Yes /\_/\_/\_/\_/
27. Do you have any other valuables (e.g. pump/sewing machine, jewelleryes)?  
1=No, 2=Yes /\_/\_/\_/\_/

How many domestic animals do you have?

28. Cows/Buffalo / \_ / \_ /
29. Goat/Lamb / \_ / \_ /
30. Hen/Chicken / \_ / \_ /
31. Pigeon / \_ / \_ /
32. Number of siblings (live birth) / \_ / \_ /
33. Birth order of the child / \_ / \_ /
34. How many children under 6 years of age live in the same area  
(Except the child) / \_ / \_ /
35. Father's occupation: 1= jobless, 2= day labourer/farmer, 3= taxi driver,  
4= service holder, 5= businessman, 6= other (specify) 9= NA / \_ /
36. Father's education (1 point for each class) / \_ / \_ /
37. Mother's education (code as above) / \_ / \_ /

### **7.3. HOME QUESTIONNAIRE**

#### **Organisation of physical and temporal environment**

1. Who looks after the child when mother is not around? 1=>2 different people, 2=one of the 2 people, 3=always the same person. Recoded to: 1=1, 2=2+3
2. A person over 12 years of age always looks after the baby. 1=no, 2=yes
3. Is child taken to the grocery store? 1=no, 2=yes
4. How often child is taken to grocery store? Recoded according to distribution: 1=not taken, 2=1-15\*/month, 3=16-30\*/month
5. Is the child taken out to a near distance? 1=no, 2=yes
6. How often child is taken out to near place? Recoded according to distribution: 1=not taken, 2=1-15\*/month, 3=16-30\*/month
7. How many times is the child taken to a far distance in 1 year? Recoded according to distribution: 1=not taken, 2=1-3\*/year, 3=4-15\*/year
8. Child's indoor play environment appears safe/free of hazards. 1=no, 2=yes
9. Indoor play environment appears clean. 1=no, 2=yes
10. Indoor play environment appears of reasonable size. 1=no, 2=yes
11. Outdoor play environment appears safe. 1=no, 2=yes
12. Outdoors play environment appears clean. 1=no, 2=yes
13. Is the home attractive with picture/decorative pieces? 1=no, 2=yes
14. Is the home very dark? 1=yes, 2=no

#### **Stimulation**

15. Does the child listen to radio/cassette? 1=no, 2=yes
16. How many days in a week does the child listen to radio/cassette? Recoded according to distribution: 1=no, 2=1-4\*/week, 3=5-7\*/week
17. Does the child watch television? 1=no, 2=yes
18. How many days does the child watch television? Recoded according to distribution: 1=no, 2=1-15\*/month, 3=16-30\*/month
19. At least one book/magazines present in the house. 1=no, 2=yes
20. If yes, how many books/magazine present in the house? Not used in analysis
21. Does the mother read book/newspaper/magazine? 1=no, 2=yes
22. How often mother reads book/ newspaper? Not used in analysis

23. Is the child ever given pen/paper to scribble? 1=no, 2=yes
24. How often are paper/pen given to the child to scribble? Recoded according to distribution: 1=no, 2=1-16\*/month, 3=17-30\*/month
25. Does father provide help with looking after the child. 1=no, 2=yes
26. How often father provides help with looking after the child? Recoded according to distribution: 1=no, 2=1-15\*/month, 3=16-30\*/month
27. Does father plays structured games with the child. 1=no, 2=yes
28. How often father plays structured game? Recoded according to distribution: 1=no, 2=1-15\*/month, 3=16-30\*/month
29. Why father does not play structured game? 0=if yes, 1=not necessary, 2= no time, 3=others. Not used in analysis
30. Is there another adult (over 12 years) playing structured game with child? 1=no, 2=yes
31. How often another adult plays with the child? Recoded according to distribution: 1=no, 2=1-15\*/month, 3=16-30\*/month
32. Does the family receive guests? 1=no, 2=yes
33. How many times does family receive guests? Recoded according to distribution: 1=no, 2=1-3\*/month, 3=4-7\*/month, 4=8-30\*/month
34. Is there another adult travelling with the child? 1=no, 2=yes
35. How often is another adult travelling the child? Recoded according to distribution: 1=no, 2=1-15\*/month, 3=16-30\*/month

#### **Maternal involvement**

36. Do you tell stories to the child? 1=no, 2=yes
37. How many days in a week do you tell story to the child? Recoded according to distribution: 1=no, 2=1-3\*/week, 3=4-7\*/week
38. Do you sing a song/rhymes to the child? 1=no, 2=yes
39. How many days in a week do you sing a song/rhymes? Recoded according to distribution: 1=no, 2=1-3\*/week, 3=4-7\*/week
40. Do you talk to the child? 1=no, 2=yes
41. How many times do u talk to the child? Recoded according to distribution: 1=0-13\*/week, 2=14-48\*/week, 3=49 and more\*/week
42. Do you teach your child anything? 1=no, 2=yes

43. How many times do u teach your child? Recoded according to distribution:

1=no, 2=1-21\*/week, 3=22 and more\*/week

44. What types of things do you teach? 1= nothing, 2= 1-2 activities, 3=3/more

45. Does the mother play with child? 1=no, 2=yes

46. How many days mother plays with the child? Recoded according to

distribution: 1=no, 2=1-14\*/week, 3=21 and more\*/week

47. Description of games (open question)

48. How many structured games? 1=no games, 2=toys/objects/physical games,

3=combination of games

49. Mother organises activities for the child. 1=no, 2=yes

50. Mother looks after the child during visit. 1=no, 2=yes

### **Play materials**

51. Number of story books/coloured pictures. Recoded to: 1=none, 2= 1-3 books

52. Number of schoolbooks. Recoded to: 1=none, 2=one book only, 3=2-7 books

53. Any home made toy that uses combination of objects? 1=no, 2=yes

54. Any toy requiring the use of hands. 1=no, 2=yes

55. Any bought toy using combination of objects? 1=no, 2=yes

56. Any pull along toy/push along toy? 1=no, 2=yes

57. Any large muscle toy? 1=no, 2=yes

58. Any cuddly toy? 1=no, 2=yes

59. Any doll or role-playing toy? 1=no, 2=yes

60. Any toy that can make music? 1=no, 2=yes

61. Any specific place for toys? 1=no, 2=yes

62. Any plastic or other toy? 1=no, 2=yes

### **Punishment**

63. Does she threaten punishment? 1=yes, 2=no

64. Does the child do anything dangerous? 1=yes, 2=no

65. How does mother punish the child-if mixed score lowest

66. Did mother punish the child? 1=yes, 2=no

67. Category of punishments: 1=verbal and physical, 2=physical, 3=verbal, 4=no punishment

68. Does she restrict the child's activities? 1=yes, 2=no

**Emotional and verbal responsivity:**

- 69. Does she spontaneously vocalise? 1=no, 2=yes
- 70. Mother responds to child? 1=no, 2=yes
- 71. Mother had verbal interchanges with observer? 1=no, 2=yes
- 72. Mother expresses ideas well and freely? 1=no, 2=yes
- 73. Does she spontaneously praise? 1=no, 2=yes
- 74. Mother voice conveys positive feelings? 1=no, 2=yes
- 75. Does she caress/stroke head/kiss the child? 1=no, 2=yes
- 76. Does she complain about the child? 1=yes, 2=no

## 7.4. PARENTING QUESTIONNAIRE

1. We know that to raise a child mother has a great role to play. What is your opinion? What do you think a mother can do in this regard? (Open question)  
Coded as follows: developmentally inappropriate = -1, neutral = 0, appropriate for physical development =1, appropriate for mental development =1, appropriate for physical and mental development=2
2. Will too much love spoil a child? 0= yes (agree completely), 1=it is likely, 2= it is less likely, 3= No (disagree completely)
3. Will too much praise make a child proud? 0= yes (agree completely), 1=it is likely, 2= it is less likely, 3= No (disagree completely)
4. Should we hit the children? 0= yes (agree completely), 1=sometimes, 2= very seldom, 3= No (disagree completely)
5. When you are very busy suppose cleaning the house or cooking, do you think you should still talk/play with the child? 3= yes (agree completely), 2=sometimes, 3= very seldom, 0= Not necessary (disagree completely)
6. Before the child reaches 3 years of age should we teach numbers/alphabets to the child? 0= yes (agree completely), 1=sometimes, 2= very seldom, 3= Not necessary at this age (disagree completely)
7. When the child can feed her/himself, can we leave him/her alone and don't care about feeding the child anymore? 0= yes (agree completely), 1=just care occasionally, 2= come and check at him frequently, 3= No, always make sure that the child is properly fed (disagree completely)
8. When the child is learning something new and making mistakes what is your reaction? Do you praise the child for what s/he is doing correctly or do you criticise her/his mistakes repeatedly? Criticise = -1, Praise=1
9. How can you feed the child if child refuses repeatedly? (Open question)  
developmentally inappropriate =-1, neutral=0, developmentally appropriate =1, If -1+0/1=0
10. How to help the child learn to speak? (Open question) coded as follows:  
harmful = -1, usual talking =0, adequate talking =1, adequate talking + playing/showing =2, harmful + any other =0
11. What can you teach to a child with a picture book? (Open question)

12. What can you teach to a child with a doll? (Open question)
  13. What can you teach to a child with pen & paper (Open question)
  14. What can you teach to a child while clothing him/her (Open question)
  15. What can you teach to a child while bathing? (Open question)
  16. What can you teach when walking around? (Open question)
- 11-16 were coded as follows: developmentally inappropriate = -1, ignorance = 0, developmentally appropriate = 1, -1+0/1=0*
17. When teaching something if s/he is not willing to learn, what do you do? (Open question) Coded as follows: developmentally inappropriate = -1, insisting negatively = -1, try at that time = 0, leave the child alone = 0, try later = 1, -1 + any other = 0
  18. How well can you manage the child? (Was not used in the analyses)
  19. How well can you control yourself when the child is bothering you? (Was not used in the analyses)
  20. How many days did you breast-feed the child exclusively? -1 = never, 0 = 1-45 days, 1 = 46-119 days, 2 = 120 or more days
  21. Have you fed colostrums? 0 = no, 1 = yes
  22. How to prepare ORS? 0 = wrong answer, 1 = correct answer
  23. Did you wash your hands before feeding the child yesterday? 0 = no, 1 = yes
  24. Did you wash your hands after cleaning your child's stool yesterday? 0 = no, 1 = yes
  25. What type of weaning food did you give to your child? 0 = no combination, 1 = 2 different combination, 2 = >2 different combination
  26. How many vaccines should we give? One point for each correct answer
  27. What is the benefit of iodised salt? 0 = wrong answer, 1 = correct answer

Questions 1-17 concerned mothers' knowledge of child rearing, 20-27 concerned mothers' knowledge of health and hygiene. Questions 18, 19 were regarding mothers' self esteem and were not used in the analysis.



## **7.5. FOCUS GROUP DISCUSSIONS QUESTIONNAIRE**

### ***Introduction***

At first, let me say that today we will discuss in a different way. Everybody usually comes to teach you certain things, we will rather like to talk to you in open mind and learn more from you.

We will talk about how we usually bring up babies from very first days- about their development, we will talk about all aspects how a child gradually develops – bodily and in their understanding (intelligence) and how we as well as different other conditions/factors help or hinder this development?

There is nothing wrong or right in anyone's opinion and we will talk in open mind – everyone of us should speak in whatever way she thinks about bringing up the child and she might say from her own experience or what she thinks about a particular aspect.

I am repeating again, you all will talk about your own feelings, we value each and every piece of your word and we will hear attentively to every one when she speaks.

In order to have an enjoyable and fruitful session; let us decide to follow certain rules:

1. We will talk one by one – if we talk all together at a time, it would be difficult for us to hear fully and we will miss some of the important points.
2. As because I may not remember all the discussion, my friend sitting besides me will note down the important points – do you have any objection about it?
3. And this is also true that she might miss some of the points, so we will record our discussion, so that we can collate later on with the notes – do you feel uncomfortable with that – we assure that we will destroy this later on.

## ***QUESTION GUIDE***

1. When usually the children start talking? We usually do a lot of things when the child starts talking, do you try a lot in order that he talks timely, what are the things you usually do in your area? If the baby delays in talking, what usually you do?
2. When the children sit independently? What do you usually do in order that the baby sits timely? If the baby delays in sitting, what do you usually do?
3. When the children start walking? What do you usually do so that the baby can walk timely? If the baby delays in walking, what usually you do?
4. How a child grows up day by day after birth, we already have some ideas about talking, sitting and walking. Can you please tell me more about another aspect of child's development – about child's intelligence – how a child starts understanding the things and about his surroundings, the way you want from him to do. Well, you have said many things; can you please tell me more about this – what else do you do in order that the child becomes more smart, understanding and intelligent? In this process of growing up, do you think that other family members should take a role? What roles do different family members, besides you play? The child's father? The child's grand mother or grand father? The child's uncle or auntie? Do you play with the child? What usually you play? Do you think playing is helpful for the development of the baby and how? For small household things/works, who should be involved most? Boys or girls? If you involve girls more in those in-house works why do you do so and what are the reasons behind that? Learning household works (like sewing, cleaning utensils, cooking etc.) or giving opportunities for playing - who should get more chance? Boys or girls? Why do you think so?
5. During feeding the baby, in order that he takes it completely, what do you do and what is usually done in your area?
6. In order to help the baby sleep early, what do you do and what is usually done in your area?
7. From what age do you consider that the baby should be taught about discipline and manners? Through what activities or which ways discipline or manners are

usually taught? Do you think in doing that sometimes you need to punish the child? In which ways?

If the child asks you about different things, and you are busy with your household works what do you do?

When do you tell your babies about right/wrong, sinful acts/rewarding acts (from the perspective of religion)

8. Who do you consider an ideal child? Which attributes you value most? what attributes you like to see in your child and you consider it ideal?

9. Do you have an access to resource, if you need to buy small things like toys, games and decorative things for the baby or spend money for education of the child?

10. For matters pertaining to your child like feeding, education or sickness, do you need to take permission from your husband? What do you usually do in case of emergency? Thank you very much for spending some time with us, we have learned many things from you, do you consider that this type of discussion is helpful for you and your child?

11. If we arrange such programmes, where you besides feeding the child in these centres will get training about the proper development of your child, how to play and how to take best care for your child – will you be able to come and spend some time? If we do it weekly, what do you think? Is it possible to find out time regularly to spend with your baby besides your many-fold involvement in household works? Do you anticipate any problem in participating in such kind of programs or doing the works at home? What about your husband and mother or father in laws – what do you think – will they accept and encourage you to participate in such programmes or will they discourage you?

## **7.6. QUOTES FROM FGDS**

- How children develop? What promotes good development?

Quotes:

“Intelligence comes automatically, it would improve as children grow, if they are not healthy, children should be given various nutritious food.”

“After feeding good food, we should confide in God.”

“It increases with age.”

“Intelligence develops spontaneously, increasing with age. Child starts to recognise one thing after another and we can also help the child to recognise objects but the child should make her own efforts to speak.”

“Mother and father help children recognise various objects, they give vitamin and vegetables to the children, and food increases their intelligence.”

“Green leaves and vegetables should be given regularly to increase intelligence.”

“Mother and father should teach; children should be given medicine.”

“Children’s intelligence improves if mother takes better food.”

“Teachings given by parents is not sufficient, children learn by seeing things around them, the child learns more when he is surrounded by many children and sees them.”

“Efforts should be taken from the time they are in mother’s womb.”

“Milk feed increases brain, brain grows if children are fed good fruits, banana.”

“They physically grow, and their intelligence also grows with that.”

“Whatever mother and father do is for child to go to school and learn so that he becomes intelligent.”

- Mothers’ perception of the causes of delay in language and motor milestones and how to deal with them

Quotes:

“In case of nutritional deficiency there is delay in talking. If born with ill health then speaks later, and if born healthy, by the grace of God, well and good. When they are in the womb, mothers should be fed well, and then the child will be born with good health.”

“Would need treatment to help speak.”

“Must be taught, fed, bathed and cared for.”

“Should be able to speak if care is provided; I would consult a doctor and follow his suggestion if my child does not speak by 2-2.5 years of age.”

“Some children start to speak early and some are late.”

“Weakness, lack of strength, nutritional deficiency cause delay in speech”

“Caring helps promote growth of children; they should be given food that helps build strength.”

“I leave it to God’s will/mercy.”

“It may be due to evil eye, possession by evil spirit or supernatural causes, in that case we need to massage with oil, give them fruits, vitamins and leafy vegetables, then the child can walk.”

“We consult with qualified doctor most of the time. Sometimes we go to traditional healers, they give water or oil blessed with the air of their breath, they also do some tricks to expel the evil spirit. If still the child does not walk, we understand that he won’t be able to walk.”

- Role of father

Quotes:

“Fathers take rest and teach children; teaches them how to count, times table, alphabets.”

“Father should teach, and bring various things for the child e.g. ball, fruits and medicine.”

“Fathers impart knowledge to their children, and affectionately say ‘daddy’ please study carefully, go to school, and if you do not read teachers would beat you.”

“Father has a definite role, he caresses and shows affection, he teaches the child, some fathers care for the children more than mothers.”

“Child will go to market with father.”

“What good fathers do, children learns from them.”

“If fathers are brainy, children will also be brainy.”

“When children grow up, fathers take them to market, shows various things to them, when they do accounting children learn.”

“For example father will give money to children to count; parents teach children about how much money is required to buy some thing etc.”

**“Teaches ‘work at the time of work, play at the time of play, eat at the time of food’ says these, would give money to count and observe if they are able to count.”**

- **Role of other family members**

**Quotes:**

**“Grandparents do a lot for the children, suppose; encourage children to go to school and to study, and advise them to avoid doing bad things.”**

**“They will teach them how to study, caress them as long as the children are at home.”**

**Grandmother says ‘my dear, if you go to school; I will give you this and that etc.’**

**“They have a role to teach, and encourage children to read, talk and to be good people.”**

**“They will hold her on their arms and play with her, when they go for a walk, they take her with them. I can’t show my anger in front of them otherwise they will scold me.”**

**“Keep children with them, feed them, care for them, clean their body.”**

**“When they pray to God they should ask children to follow them.**

**“Give money to the children and make fun with them, and send them to school.”**

**“Younger uncles bath children, advise them not to play with dirt and not to beat people, and warn them about punishment if they do so.”**

**“Take children on their lap, love them, kiss them.”**

**“Paternal uncles bring interesting things from market, walk taking children in their arms.”**

**“Aunts bath them, massage their body with oil, and wear them clothes and shoes. Tell children, “call me, if you do, I would give you interesting thing to eat, I would take you with me, will bring you clothes.”**

- **Role of play**

**Quotes:**

**“It is an exercise. Keeps the child healthy.”**

**“Play helps make better physical growth.”**

**“Playing improves health.”**

**“Child feels happy and enjoys. Some children forget their hunger when they play.”**

**“When they play with other children they get a lot of amusements.”**

**“If they play, mother will have time to do other works.”**

**“Improves knowledge and intelligence. Gives them courage. As they are intelligent they play. In other words, because they are intelligent they can play.”**

**“When they play with another one, they learn. Then they will learn that they should not fight with each other.”**

- **Gender differences in play, work, and opportunities**

**Quotes:**

**“I give more opportunity to my daughter to work, while allow my son to play more. My daughter makes the bed, arranges the clothes and sweeps the rooms.”**

**“Girls should do more house works.”**

**“Girls do more works than boys; they make beds.”**

**“Boys have more opportunity to play.”**

**“Would give house works to girls, and give sons works done by males. Would give the girls cooking pots to play, and balls to the sons.”**

**“Would give greater playing opportunity to boys; would ask girls to clean rooms, beds, do this work, clean kitchen utensils.”**

- **Punishment/reward**

**Quotes:**

**“Scare them, tell them that the mad man or the dog will come.”**

**“Beat if s/he does not listen; if I get angry then I beat them.”**

**“Suppose if he is going with another child and quarrels with him, I would beat him as well as the other one, then tell him not to go and play with that child. I bring him home with the hope of giving him something, but sometimes I have to beat him too.”**

**“It is needed to scare and discipline them. Otherwise whatever they wish they will do. Must scare them with angry looks. If we beat them they will be more daring, only must scare them.”**

**“If the child is able to understand the meaning of beating, then can beat him, if he is still unable to understand that, there is no use to beat him and must only scare him.”**

"First we must talk to them in loving words like 'my dear, my son', then must warn and threaten them."

"Caress him and tell him you have done very good."

"I feel happy. Hold him on my lap and kiss him."

- Care practices

*Feeding practices*

Quotes:

"Children should be distracted by showing various objects around and promise to give them what they want. I show him so many things while I feed him."

"If a child is reluctant to take food, s/he could be amused and given some thing to play with."

"Scare them, tell them that the mad man or the dog will come, or that another child will come and eat your food."

"Tell him that dog or jackal will come and beat you. Father will come and beat you. If after all these he doesn't eat, I leave him and keep the food away."

"Sometime I need to show her the moon in the sky and then she eats."

"Tell her that your grandpa is coming to beat you or if you eat I would give you money or would take you there, then she eats quickly."

"I feed by taking her on my lap and walking around the house."

"Your brother is eating his food, eat quickly, or else he would take your food too, he then eats."

*Bedtime practices*

Quotes:

"When I caress his body with affection, he falls asleep."

"Sometimes need to say bedtime stories."

"To be offered breast milk and patted on the back to fall asleep."

"I stretch my legs and put my son on my legs and gently shake my legs and he falls asleep."

"When the child is given bottle, he falls asleep."

"If after bath, his body is massaged with oil and offered breast milk, he sleeps."

"If very much sleepy, sleeps spontaneously."



"If I lied down on bed with the child and offer her/him breast milk, goes to sleep."

*Playing and attending to the child's needs*

Quotes:

*Play*

"Make them earthen oven, husking equipment for them, pretend to cook rice and other foods, and ask them to play."

"Sometimes play with them in between my works. Play with various things- play and laugh with them."

"Make doll and rattle for them, pretend to cook and give them other things"

*Attention to child if busy*

"Must answer them if they ask any question."

"Give a biscuit and ask him/her to eat and leave. If I am busy talking with others scold and ask him/her to leave, and if I am at work tell him that I would listen to him after finishing my work."

"If I explained the situation she leaves the place; otherwise I try to drive her away; tell her I would give you money if you leave."

"My child does not come to me; if comes transfer her/him to some other person."

"Give him a slap, tell him: why do you bother me like this; can't you see that I am talking?"

"Give him money to go and buy some thing if I'm busy."

"Give something and tell him that I would listen to him later."

- *An ideal child*

Quotes:

"Be obedient. Behave well with the people."

"Study hard. Respect elders and love youngers."

"There are many children who study well, but are not obedient to parents. Then parents feel bad and upset and think that it was useless to send him to school."

"Must be good in all the manners."

"If he is not obedient it is not good. Others do not like those who carry on their own wishes."

"If the child speaks in an organised way, plays, calls grandfather and grandmother with respect, responds to my call."

"Plays happily, does not disturb while I am cooking or doing other household works, if told to do something and he does that."

"If says meaningful words- 'mother please give me this'; if speaks to and talks with wisdom; if does not do bad things, talks respectfully."

"If does not quarrel with others, if no body complains against and says good about the child."

"If he fears God and pray 5 times a day."

- Access to resources

Quotes:

*Financial autonomy*

"I try to earn myself. I like to meet my son's needs, so I have started a farm and keep chicken and duck. I sell their eggs and earn money to buy whatever my son wants."

"By selling the eggs of chicken and duck I make a small earning. I need to do everything for my children. I keep these earnings in a separate place. I only give account of what my husband gives for the family to him."

"It is possible to meet the needs of the family with what he gives."

"I do not need to pay any money to my son, grandpa and grandma give with pleasure."

"When he goes to school, I ask his father to leave behind some money for the child; children need to be given some money when they go to school; his father gives the money."

"I'll ask my husband. Husband is older, he understand better and more than me."

"I'll ask my husband and then spend. Both of us will discuss together put our minds together and take decision."

"Money is kept with paternal auntie, I take from her. She says, so what if the father is not home? I have money take that."

### *Decision-making*

**"If the child is sick I'll wait for my husband even if he is late."**

**"If my child is sick I won't wait. Even if I don't have money with me, I'll borrow from someone and take my child to doctor."**

**"I'll take him even if I have to go with others, or will take him all by myself."**

**"I'll take someone to accompany me."**

**"Ask the grandfather of the child, if he would take the child to doctor, when the father of the child returns they tell him."**

- **Having a programme of child development, a need, problems and willingness:**

#### **Quotes:**

**"We need to be educated for the sake of our children."**

**"When mother and father are educated then they will be able to educate their children."**

**"I'll take care of all my works at home and then will come. They won't tell me anything."**

**"Our husbands will understand it because they know it is for the good of our children."**

**"Many problems may arise; there are other family works. Mother-in-law may say what is she doing? Playing with the child for 2 hours? She has got so much work at home."**

**"I'll explain. There won't be any problem."**

**"I'll ask for the view of my family and then will come."**

**"They will let me come, because it is for the welfare of my children. There will not be any problem."**

**"They will send me, I can take permission. I'll finish my housework and then will come. Nothing wrong will happen."**

**"Would deal with it after completing housework. Would finish all works during the day, and play with the child at night."**

**"Would deal with it after finishing all home works and convincing my mother-in-law." "Would be able to come leaving behind work."**

**"I have work to do, my mother-in-law would scold me."**

**"Some husbands understand and some do not."**

## **7.7. TOPICS COVERED IN THE GROUP MEETINGS**

### **Session 1**

**Topic: Introduction to the programme and to each other**

#### **1. Introduction**

- Each mother gives her name and the child's name
- Tell age of the child and ages of other children in the family
- Add up ages of the children in each family
- Write the number of years down for each mother
- Add up the total number of years. This shows the amount of experience in the room and gives mothers a lot of self confidence

#### **2. Explain about the programme. Points to include:**

- Special research programme
- Looking at how best we can help young children grow and learn
- Parents can help children grow up happy and smart
- This programme helps you to improve your child's development because:

### **The Age Range 0-3 Years is Important for Child Development**

Children develop throughout life and the first three years of life is the most important stage in child development. This is because children develop very quickly in the first three years of life. For example,

- By six months the baby has doubled his weight at birth
- By age one year the baby has tripled his birth weight.
- During the age from birth to three years the majority of connections in the brain are made
- The age range 0-3 has many sensitive points including:
  - \* Weaning
  - \* Learning to move independently - crawling, walking
  - \* Learning to understand spoken language
  - \* Learning to speak

**3. Timing of the programme:**

- Once a week at the CNC for 10 months
- Fortnightly at the CNC for 2 months
- Twice a week at home for the first 8 months
- Twice a week at home for the next 4 months

**4. Contents of the programme**

- Share ideas on how to help children grow and learn
- Share any problem we have
- Things to do with children
- Make toys and pictures for the children

**5. Messages to share:**

- We all need to learn from each other. This means that: the Play Leader can learn from mother, mothers can learn from each other, mothers can learn from the PL
- Things we want for our children: write down what mothers say. It may include:
  - ♥ To be healthy
  - ♥ To do well at school
  - ♥ To be happy
  - ♥ To have friends
  - ♥ To be good
  - ♥ To be able to do things independently, e.g. eating, dressing, washing
  - ♥ To be polite
- Why parents are the most important people? Write down what the mothers say. The following points may be used:
  - ♥ Parents spend a lot of time with their children
  - ♥ Parents love their child
  - ♥ Parents want their child to do well
  - ♥ Parents know their child well, they know their children's likes and dislikes
  - ♥ Children love their parents

♥ Use the points they make to tell mothers that parents are the most important people for the child

#### 6. Ground rules:

You must establish a set of ground rules for everybody to follow. Discuss these rules with the group of mothers and let them understand the importance of these rules and how they will help smooth running of the programme. If any of the mothers wants to add any more rule, or modify some of them, discuss it with all of them and decide with the whole group whether to accept or not. If the suggestion is good and practical and if the group agrees to it, you may add it but keep a note of the changes you have made.

- The group should work as a close family
- Everybody should respect and help others
- Different people have different skills, talents, and temperament. We should all recognize this fact and appreciate it. Therefore everybody should be respected equally
- We should not feel shy and must frankly express all our ideas, but no one will be forced to talk if they don't want to
- Everybody can ask questions if they don't understand
- We all should be punctual
- While in this programme, we may get to know about the private thoughts and personal problems of others in the group. We should therefore, maintain absolute confidentiality of others' secrets

## **Session 2**

### **Feed back**

1. Each mother to tell one of the ground rules.
2. Each mother to say one point on why parents are the most important people.
3. Each one to say a reason on why 0-3 years is an important age range for children.
4. Tell any problem they had.

### **Topic: Importance of PLAY**

Play is vital for children's development in every area (emotional, intellectual, social, physical). There are several different kinds of play. Two or more of these are usually mixed together.

Ask parents what they know of the importance of play. Note down what they say and add up to it if anything is missing from their list. The list may include the following points:

- Child enjoys playing
- Child feels happy
- It is needed for the child's mental development
- Children learn many things through play
- Children explore and enjoy social interactions, relationships and feelings
- Children explore and enjoy their senses of light, colour, movement, sound, rhythm, taste, odour, texture and find pleasures in own body
- Child exercises new found abilities (dropping, walking, throwing, carrying, piling)
- Child explores and tries different social roles - mommy, daddy, policeman, shopkeeper, pilot, driver, etc. This is vital to the child's development, to learning, and to the child becoming a member of family and society. Many people fear what might become of a boy who plays with dolls - "Dolls are for girls. Trucks are for boys." Playing with dolls encourage the development of feeling of tenderness, caring, protectiveness, and responsibility. Is it wrong for boys - men - or fathers to have these feelings?

### Session 3

#### Feedback

1. Each mother to tell why play is important for the children.
2. Tell any problem they had during the last week.

#### Topic: It is important that we show children we love them

##### Discussion points:

1. Why do we need to show our child that we love him/her?
  - Make a list of what the parents say.
  - Discuss what the parents have said and add any more reasons
  - Put on the black board a few of the best reasons

##### Why it is important to show love:

- |                                  |                                   |
|----------------------------------|-----------------------------------|
| • it helps your child feel:      | • your child will be caring       |
| ◇ wanted                         | • your child will be loving       |
| ◇ good                           | • your child will love you back   |
| ◇ happy                          | • parents are most important to a |
| ◇ important                      | child                             |
| • your child learns to trust you | • your child will be confident    |

##### Remember to praise the parents when they make a contribution

2. How can we show children we love them?
  - Make a list of what the parents say
  - Add any more ways which have not been included

##### We show love to our child by:

- |                                 |   |
|---------------------------------|---|
| • kissing our child             | • praising our child                      |
| • cuddling our child            | • listening to our child                  |
| • smiling at our child          | • including our child in the things we do |
| • touching our child            | • responding to our child                 |
| • looking into our child's eyes | • using a loving tone of voice            |
| • playing with our child        | • singing with our child                  |

3. Ask each parent to act out one of these ways with their child, for example



- Talking to the child in a loving voice while making eye contact and smiling
- Cuddling the child and saying “you are a bright girl/boy”
- Kissing their child on the hands and face

Remember to point out the good things that parents do

Remember: comment on how parents show love to their child.

Parents to practice showing love during week

#### Session 4

##### Feedback

1. Parents to tell one way they showed love to child last week
2. Parents to tell any problem they had showing love

Remember to praise the parents for good contributions

#### Topic: It is important to praise your child

##### Discussion Points:

1. Think about one time when you did something well and someone praised you.

How did you feel?

- Make a list of what the parents say

2. Now think of when someone shouted at you for getting something wrong.

How did you feel?

- Make a list of what the parents say

##### Examples may be:

When we are praised we feel:

- ◆ Good
- ◆ Confident
- ◆ Clever
- ◆ Happy
- ◆ Want to try again

When we are told we are wrong we feel:

- ◆ Sad
- ◆ Stupid
- ◆ Useless
- ◆ Give up trying
- ◆ Angry

3. Why is it important to praise children? Discuss. (see above)
4. How do you praise your child?

**For example:**

- Saying 'Good boy' or 'Good girl'
- Smiling
- Thanking
- Hugging
- Clapping
- Kissing

5. When do you praise your child:

- Praise your child when she does something well
- Praise your child when he tries to do something but gets it wrong
- Praise child just for being who she is

6. Think of one thing your child has done today or yesterday.

*How would you praise it?*

- Ask each parent to give one example
- Ask each parent to role play praising child

**Examples:**

The child hugs you                      Hug her and say: "Good girl, a hug"

The child smiles at you                Smile back and say "Good boy, you're smiling"

7. We can also praise a child for just being who she is.

Tell me one thing you like about your child.

Examples are: child's eyes, child's smile, child's hair, child plays nicely, child dances and so on.

It is good to let your child know that you like this.

- Ask each parent to say what they like about their child
- Role play letting child know they like it

**Important points to demonstrate in playtime activity**

- Look for good things in the child
- Don't let the child feel bad if he fails
- Make sure the child can do well
- Help the mother do this by pointing out positive things about the child
- Make a task easier so child can do it

**Take home Task**

Praise your child when good

## Session 5

### Feedback

1. Parents tell one time when they praised their child last week
2. Parents tell any problem they had praising their child

### Topic: Helping Our Child Learn

#### Discussion Points:

1. Think of some things children learn to do.
  - Discuss what the parents say

#### Some things children learn are:

- |                        |                           |
|------------------------|---------------------------|
| • to walk              | • to pick things up       |
| • to talk              | • to bang things together |
| • to understand        | • to drink from a cup     |
| • to eat by themselves | • to wash                 |

2. How do children learn?

- Write down what the parents say
- Add any more ways
- Put on blackboard a few of the best

#### *Children Learn By*

- |                                     |                        |
|-------------------------------------|------------------------|
| • watching other people             | • touching things      |
| • copying other people              | • playing with things  |
| • doing it with someone else        | • doing things         |
| • trying over and over again        | • looking at things    |
| • being shown how                   | • chatting with people |
| • getting it wrong and trying again |                        |

3. How can we help our child learn?

- Discuss with the parents

#### We can help children learn by

- |                             |                                |
|-----------------------------|--------------------------------|
| • looking at what he likes  | • showing him how to do things |
| • doing what he likes       | • look at things with him      |
| • helping him               | • playing with things with him |
| • encouraging him           | • chatting with the child      |
| • praising child for trying |                                |

3. Show 5 steps to teach child

**Step 1:** Do what child wants to do first

**Step 2:** Then show the child new task

**Step 3:** Do task together

**Step 4:** Child tries alone

**Step 5:** Praise the child if he does it right. Help child if he does it wrong

4. Parents to act out the 5 steps

- Comment on what the parent does well
- Help her to do it better

**Remember**

- Don't force the child to do it
- Break it down into smaller tasks
- Don't let the child feel bad if he does it wrong
- Make sure the child can succeed

**Take Home Task**

Use 5 steps to helping your child learn

**Session 6**

**Feedback**

1. Parents tell steps they used to help their child learn
2. Discuss any problems

**Topic: Communicating with your Child**

**Discussion Points**

1. What different ways does your child use to communicate?
  - Write down what the parents say
  - Add any more ways

*Prompt the parents    How do you know your child is hungry?*

What does he do if he wants something? When she is happy, what does she do?

How do you know when he is angry?

**Babies and young children communicate by:**

- |                                    |                               |
|------------------------------------|-------------------------------|
| • crying when hungry or hurt       | • looking at the mother       |
| • smiling or laughing when happy   | • bringing a cup when thirsty |
| • pointing                         | • making sounds               |
| • reaching                         | • saying a word or a phrase   |
| • putting arms out to be picked up | • pulling a face              |

2. Observe the children and discuss:

- How are they communicating ?
- What are they communicating?

3. How do you communicate with your child

- Get the parents to role play the different ways

**Parents communicate by:**

- |                                 |                                      |
|---------------------------------|--------------------------------------|
| • talking to the child          | • kissing and cuddling the child     |
| • smiling at the child          | • singing with the child             |
| • looking into the child's eyes | • pointing to things                 |
|                                 | • using actions, e.g. waving goodbye |

4. A good way to help our child learn to talk is to share in what he likes to do and to talk about what he is interested in.

Review 4 steps to sharing what our child likes to do.

- **Observe:** what is the child doing or what is he interested in
- **Wait:** give your child a chance
- **Listen:** to the child - what is she trying to tell you
- **Respond:** to your child

5. Parents practice observing child.

- What is the child interested in
- What is the child trying to tell you
- Respond to the child
- Talk about what they are interested in

**Home Task**

1. Parents to watch for how child communicates during week
2. Parents to think about how they communicate with child

**Session 7**

**Feedback**

1. Each parent tells 2 ways child uses to communicate
2. Each parent tells 2 ways they communicate with child
3. Parents report any problems

## **Topic: Making mealtimes a special time**

### **Discussion Points:**

1. What foods does your child eat? Write down the foods the child eat

Discuss with parents which foods are good for the child

Remind parents how to give their child a good diet

2. It's not only what we give our child to eat that is important.

The way we feed our child is important and will affect how much the child eats

What can we do to help our child eat?

- Encourage parents to say how they help their child eat
- Praise parents for good ideas

Examples of how to help a child to eat are given overleaf

3. What problems to you have feeding your child?

Discuss problems and encourage the parents to suggest ways of overcoming these problems

- Encourage parents to help each other by sharing experiences
- Encourage parents to think of different things they can do

### **The following points should be covered:**

- |  |   |
|--|---|
| • sit with your child while she eats,          | • don't make a fuss if child is messy -   |
| • talk to her                                  | • feed child in a place which is easily cleaned   |
| • encourage her to eat                         | • show your child how nice the food is by eating it yourself  |
| • use two spoons - you have one, child has one | • feed your child often   |
| • help your child to eat                       | • if child can feed herself with her fingers give her finger foods as well as her meal - this will encourage her to eat |
| • offer more food                              |   |
| • watch to see how much child is eating        |   |
| • have a separate bowl for the child           |   |
| • try to be calm if child refuses to eat       |   |
| • praise child for eating well                 |   |

### **Home Tasks**

1. Parents tell how they will help their child eat
2. Parents practice helping their child eat

## **Session 8**

### **Feedback**

1. Parents tell how they helped their child eat last week
2. Discuss any problems
3. Parents to think of more things they can do to help their child eat

### **Topic: Singing with your child**

#### **Discussion Points:**

1. **Review: How to communicate better with your child**

Can parents remember how to communicate better

- a) **Get face-to-face:** sit at the same level as the child
- b) **Use actions:** for example, 'shhh' with finger to lips, wave hand and say 'bye', shake head and say 'no'
- c) **Imitate your child:** for example, child says 'oooh', you say ooh'
- d) **Take turns:** you have a turn, child has a turn
- e) **Give it a name:** label things and tell children what things are
- f) **Repeat things:** Say the same things lots of times by looking at the book again and again

#### **Remember to Observe, Wait, Listen and Respond**

2. Ask parents to give example and to demonstrate these ways of communicating better
3. Tell parents that when we sing we can do lots of these things and communicate better.

#### **Demonstrate singing**

- sing face to face
- take turns
- use actions
- encourage child to imitate you
- pause while singing and wait for child to get you to carry on
- repeat, repeat, repeat
- don't sing too fast – let child hear the words

**4. Practice singing with children sitting on parent's laps**

Encourage parents to smile, sway their body, clap hands and have fun  
Sing songs 5 & 6.

**5. Why is it good to sing with our child?**

**It is good to sing because**

- it is good fun      • repeating songs gives child a chance to learn
- child learns new words      • we can get child's attention
- child learns new actions      • child learns to take turns

**6. Remember it's OK to make up your own songs**

e.g. sing about getting dressed; sing about going for a walk

**Home Tasks**

1. Parents to sing with child using the things learnt today – e.g. sing face to face, use actions

**Session 9**

**Feedback**

1. Parents talk about singing with their child
2. Discuss any problems

**Topic: Things to do at Bath time**

**Discussion Points:**

1. Discuss with parents that bath time can be a special time.

At bath time we can show love, play, talk and have fun with our child.

2. Are there any special little games or activities that you do at bath time?
  - Each parent tells of any special thing they do with child at bath time
  - Ask parents to role play activity with their child
3. What other things can we do at bath time?
  - Discuss and role play things to do at bath time

**Use Questions to Prompt Mothers**

- |   |                           |
|---|---------------------------|
| • How can we show child love at bath time?            | • What words can we use?  |
| • What turn-taking games can we play?                 | • What songs can we sing? |
| • What can we talk about?                             | • What games can we play? |
| • How can we communicate with our child at bath time? |                           |



#### 4. Bath a child (or a doll) and demonstrate these activities

##### Get parents to act out activities

##### Ideas for Bath time

- Show love by touching and kissing the baby
- Encourage baby to take turns splashing      Say: "Mummy splash    Baby splash"
- Take turns making noises      You say "oooh"    Child says "ooooh"
- Play peep-a-boo (see Baby language F)
- Talk about body parts (see Baby language G and language - body parts)
- Sing songs 2,3, 4 & 5
- Talk about washing - use words 'dirty', 'clean', 'wet', 'dry'
- Give child empty plastic bottle - encourage her to fill it up and empty it out

##### Take Home Tasks

1. Mothers choose 2 activities to do at bath time

#### Session 10

##### Feedback

1. Each mother tells 2 things that can be done during bathing
2. Each mother tells 2 things that they did during last week while bathing their child
3. Parents report any problems

#### Topic: Getting Your Child's Attention

##### Discussion Points:

1. Young children learn from their parents. Before teaching your child you need to get his attention.
2. Sharing your child's interests – is one way of getting your child's attention.

##### Review 4 steps to sharing your child's interests

- Observe: what is the child doing
- Wait: give your child a chance
- Listen: to your child – what is she trying to tell you
- Respond: to your child

3. Parents give examples of how they follow child's interests. Think of what they say to their child.

For example: "Baby reached for the spoon. I gave him the spoon."

Parent could say: "You want the spoon".

4. Another way to get your child's attention is to show her things.

**Follow 3 steps:**

Show your child something

Name it

Talk about it

**Example:**

'Look' (point to bath) 'Your bath'

'It's bath time'

'Make baby nice and clean'

5. Demonstrate Show, Name, Talk

Parents practice getting child's attention using Show, Name, Talk

#### **Take Home Tasks**

1. Parents to practice getting child's attention using Show, Name and Talk
2. Parents do 2 new activities at bath time

### **Session 11**

#### **Topic: Things to do Getting Dressed**

##### **Feedback**

1. Parents give example of how they drew their child's attention during the week using Show, Name and Talk
2. Discuss any problems

##### **Discussion Points:**

1. Review: What things do parents do at bath time? What does their child like best?
2. What things can we do when child is getting dressed and undressed?

Use questions to prompt the parents.

Which of the bath time activities can we do? How can we show love?

What turn-taking games can we play? What can we talk about? What words can we use? What songs can we sing?

3. **Demonstrate these activities**

Ask parents to demonstrate these activities (see next page)

4. **Encourage the use of Show, Name and Talk**

For example: Where's your dress. It's a red dress.

Mummy has a blue dress.

**Remember to communicate better: Use actions (e.g. point to dress)**

**Be face to face with child, Repeat every time child gets dressed**

**Ideas for Getting Dressed**

- Show love by touching and kissing the baby
- Do lap-play activities
- Do turn taking games
- Take turns making noises: You say "oooh" Child says "oooh"
- Play peep-a-boo
- Talk about body parts
- Sing songs
- Talk about getting dressed
- Play games

**Home Tasks:** Ask parents to choose 2 activities to do getting dressed and undressed

**Session 12**

**Feedback**

1. Parents talk about activities they do while dressing/undressing their child
2. Discuss any problems

**Topic: Learning to Trust your family and friends**

**Discussion Points:**

1. Think of someone you trust. What makes you trust them?

**For example:**

- You know they like you
- You can tell them things
- You know they won't hurt you

**2. Why do children need to learn to trust?**

**When children trust they:**

- |                      |                        |                        |
|----------------------|------------------------|------------------------|
| • feel safe          | • are happier          | • are less anxious     |
| • play more          | • learn more           | • mix more with people |
| • may be less clingy | • will be less naughty | • are more adventurous |

**3. Your child needs to know you love her, that you are there when she needs you and that you will act consistently**

**How can we help children learn to trust?**

**To help children learn to trust:**

- |   |                                   |
|---|-----------------------------------|
| • show love                               | • listen to your child            |
| • be consistent                           | • try not to scream at your child |
| • try to understand what your child wants | • tell her 'no' calmly            |
| • respond to your child                   | • explain things                  |
| • don't beat your child                   | • praise your child when good     |

**4. Discuss "What would you do?" in different situations**

**For example:**

**What would you do if you were going out and leaving your child with someone else?**

- Tell the child you are going out
- Tell the child when you will come back e.g. by dinnertime, before bedtime
- Give child a kiss and a hug

**What would you do if your child did something well?**

- Praise the child - tell her she is clever and that she has done it well
- Kiss her

**What would you do if your child is doing something naughty?**

- Tell her 'no' (without shouting)
- Tell her why she mustn't do it
- Distract her with something else

**5. Showing love to our child helps them learn to trust**

**How do we show love to our child? (Review from session 2)**

**We show love to our child by:**

- kissing
- cuddling
- smiling at our child
- touching our child
- looking into our child's eyes
- playing with our child
- praising our child
- listening to our child
- including our child in the things we do
- responding to our child
- using a loving tone of voice
- singing with our child

**Take Home Tasks**

1. Think about how you help your child learn to trust
2. Remember to show love to your child and to praise child when good

**Session 13**

**Feedback**

1. Parents tell of one thing they did to help child learn to trust
2. Discuss any problems

**Topic: Children's feelings are very strong and they need to learn to understand and control these feelings**

**Discussion Points:**

1. Discuss about feelings with the parents

**What feelings does your child show? e.g. love, anger, fear, joy, upset**

**How does she show you these feelings?**

**For example:**

- Baby shows happiness by smiling or laughing and wriggling
- Child shows she is scared by clinging to mother
- Baby shows he is upset by crying
- Child shows anger by hitting
- Child shows love by hugging you or running into your arms or leaning against you

**N.B. Explain to parents why children get upset when their mothers leave them.**

**Separation Anxiety**

Children from about 8 months cry when their mother leaves them.

They don't yet understand that their mother will come back.

They cry because they love their mother and want to be with her.

They also get scared of strangers.

Slowly children learn that their mother will come back and they cry less

**2. Explain that children's feelings are very strong.**

Children need to learn to understand and control these feelings.

They learn this when:

- you respond to their feelings
- you explain their feelings to them
- you are a good example

**3. Discuss examples of 'What would you do?'**

**For example:**

**What do you do if your baby shows you he is happy**

- Smile and laugh with him
- Show him how happy you are

**What do you do if your child is upset when you leave**

- Kiss him and give him a hug
- Tell him you are coming back
- Don't get cross - stay calm and he will learn it is OK

**What do you do if your child is aggressive - hitting, biting and kicking**

- Explain to child that hitting another person hurts them and makes them sad
- Take her away when she hits or bites
- Praise her when she is good - tell her she is a big girl
- Be a good example - do not hit or shout or the child will learn aggression is OK

**What do you do if your child is frightened**

- Tell child it is OK
- Show love to child so she knows she can trust you
- Don't show that you are angry or frightened yourself
- Don't force her to do something if she is frightened

**Take Home Tasks**

1. Observe your child to see what she is feeling
2. Respond to your child's feelings

**Session 14****Feedback**

1. Parents tell what feelings they found in their child last week
2. Parents tell how they responded to their child's feelings

**Topic: How to manage our children**

We all like to have a child who is well behaved and disciplined. What kind of child do we call disciplined?

Let mothers give their opinion. They may say any of the followings:

- Child who listens to parents
- Respects elders
- Is good in studies
- Obedient to elders
- Does not say bad words
- Does not hit others
- Eats well
- Dresses well
- Keeps clean

Now ask mothers how they usually try to teach discipline to their children or what would be their reaction if the child does a wrong act or does not listen to what parents ask him/her to do. They may come up with ideas like:

- Give them good advice

- Teach them how to behave
- Distract them
- Take away the toy from them

**You may add the followings if they don't mention them:**

- Explain to the child in very soft language what is good and bad
- Use a friendly tone when asking child to do something
- Praise child for good behaviour
- Ask the child if s/he thinks his/her behaviour was appropriate and what could be the appropriate behaviour, let him/her decide about the right action
- Tell her/him that mummy will be sad if he does that
- The child may be seeking attention and if we don't pay him/her enough attention s/he will try to draw our attention through negative means, so we must always ensure to give him/her enough attention even though we may be tired or busy.
- We may distract his/her attention to another activity

**What kind of punishments mothers give to the child? Ask mothers to say how they usually punish their children. They may say: shouting, hitting, threatening, verbal abuse, not giving food, not letting play or go out of house.**

**Now let us think and find out what are the times that we usually punish our children more often? Let mothers think and tell you.**

**After they have mentioned their views you may help them by giving the following examples:**

- When I am tired and want to rest but the child is disturbing me by asking something which is not important.
- When I am angry for any reason.
- When I am angry/upset with the child's father who has given me a tough time.
- When people are criticizing my child's action.
- When others tell me I must hit my child otherwise s/he will be spoiled.



- When he repeats an action in spite of reminding him not to do that.
- When he commits a sin which is intolerable for me.

So we all agree that most of the time it is not the child who is making a mistake and sometimes we are in a condition that we can not control ourselves due to some form of stress that we beat our children.

When you were a child and did something wrong and were punished for that, which of the above punishments do you think were more effective? How did you feel when you were hit for a wrong action? Did that hitting stop you from repeating that action?

What do you think the child may feel when hit or verbally abused? Let mothers express their opinion. You may add up the following if the mothers don't mention them:

- Hitting will totally pervert and destroy their character. They become rude.
- S/he will lose her/his confidence in parents and in other adults.
- Hitting will make a child lose the sense of self-respect and s/he will grow to suffer from inferiority complex. S/he will not persevere in his tasks and will give up very soon.
- It will destroy the child's sense of shame. S/he will be more daring and slowly you have to hit her/him harder and more than before and there will come a time when hitting will have no effect and the child will start to rebel against what you tell her/him to do.
- S/he will start gradually to use the same abusive words to her/his peers and may go as far as telling those words to his parents or other elders in the family.
- S/he may become a cruel and revengeful individual and start beating other peers and even adults.
- S/he will treat others as s/he was treated.
- The child will be deprived of developing kind-heartedness and tender and delicate feelings, which are absolutely necessary for his/her social development.

Now discuss with them what to do when you are about to beat or punish your child. Let mothers give suggestions. You may help them with the following words:

- First think carefully and decide if the child's action was really wrong or your anger towards him/her was due to other reasons in your life (which were already discussed).
- Gently but firmly tell the child that what he did was not right or that he should do as he is told.
- Children should be trained at home in such a way that the slightest lack of attention from the mother or father is in itself the greatest punishment. This can only be achieved through kindness and the use of soft speech.
  - Tell him/her you are saddened by his/her behaviour and will not talk to him for the next half an hour or a certain period of time
  - Do not smile at the child for a certain period of time
  - Do not play with the child for a certain period of time
- Never say something which you can not put into action, so if you really decide to punish the child think of some punishment which are possible to perform and once you tell the child that suppose you will not take him/her to the aunt's house you should not do that but do not make exaggerated threats which can never be put into practice like 'I'll chop off your head' or 'I'll give you to the jackals to eat', etc.
- If s/he repeats that action increase the time of punishment and clearly explain to him/her what is the reason.
- Try patience with the child and you will see the result to be much better than beating or abusing him/her.

## **7.8. MID-TERM EVALUATION**

Approximately 8 months after the initiation of the study 25% of cases were randomly selected from each group for additional evaluation. There were 27 children in each of the malnourished groups and 26 in the adequately nourished group. As this type of intervention had never been done before in Bangladesh we wanted to obtain a rough idea of the children's progress and determine if the programme needed to be modified. We were not necessarily expecting significant differences among the groups, as the numbers were small. The scores would also give an indication of the timing of any developmental or behavioural change.

Figures 8.1. and 8.2. show histograms of the groups' mean MDI and PDI at the 8-month test as well as their initial and final assessments. There was a tendency in all three groups for scores in MDI to decline at the 8-month test. There was an encouraging trend of an intervention effect in MDI at 8 months with the intervened group declining less than the control malnourished group (mean difference = 6.9,  $p=0.075$ , 95% CI= -0.72, 14.5). This difference was probably large enough to be of clinical significance and if the same difference occurred across the whole sample the difference would also be statistically significant. We were reassured that the intervention was benefiting the children's development and decided not to make changes. At the end of the study there was a tendency for an increase in scores in all three groups but the intervened group remained ahead of the control group.

In contrast to the MDI scores, the intervened malnourished and the adequately nourished group showed no decline in PDI but a very small increase in scores whereas the control malnourished group showed a decline. The intervened group was 7.0 points higher than the control malnourished group but the difference was not significant (mean difference = 7,  $p=0.2$ , 95% CI= -3.0, 17.0).

By the end of the study, the intervened malnourished group had continued to improve a little in PDI but the control malnourished children had improved more and they were now similar to the intervened malnourished children.

### **Discussion on the result of 8-months evaluation**

The difference between the groups was our main focus and the findings suggest that the intervention made an initial benefit to MDI but there was no further improvement in the last 4 months. In PDI there was also a suggestion of an initial

benefit in the intervened group but the control malnourished group subsequently caught up.

The dip in MDI in all three groups at the 8-month test was surprising and we speculate there are several possible explanations. The sample was small and consisted of only 27 children in each of the malnourished groups and 26 in the adequately nourished group. We checked to see if the decline in MDI was significant at 8 months within each group. The malnourished control children declined 12 points and it was highly significant ( $p < 0.001$ ). The decline in the intervention group was 5 points and was not significant ( $p = 0.08$ ), neither was the decline in the adequately nourished group (decline = 3.7,  $p = 0.3$ ).

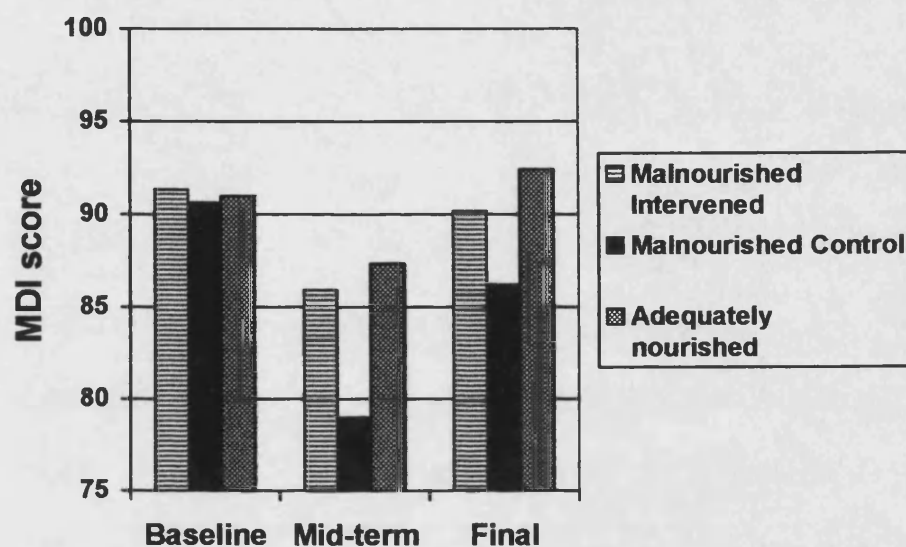
The smallness of the sample could account for the rather wide fluctuations, which could be chance. However, as all three dipped we also suspected that there might be some differences in the performance of the testers or the test properties.

We had 3 testers at the beginning of the study. One of them left after the baseline tests were completed. For the 8-month evaluation, children were tested by 2 of the 3 testers who tested the children initially. For the final tests we recruited another tester to complete the tests. We trained them rigorously to be consistent in their testing. In addition, as far as possible the testers tested equal numbers from each group at all sessions so that the differences among the groups should not be affected if they tested slightly differently from each other. We conducted a number of analyses to check if the testers scored differently. There was no difference on ANOVA, or multiple regression controlling for group among the 3 testers at baseline or final tests. There was however a significant difference on MDI between the two testers at the 8 months tests (t-test, ANOVA, and multiple regression) and it is likely that one of them underscored the children, which resulted in the dip in scores. However, when we looked only at the tester with the higher scores the dip at 8 months remained as did the relative position of the groups

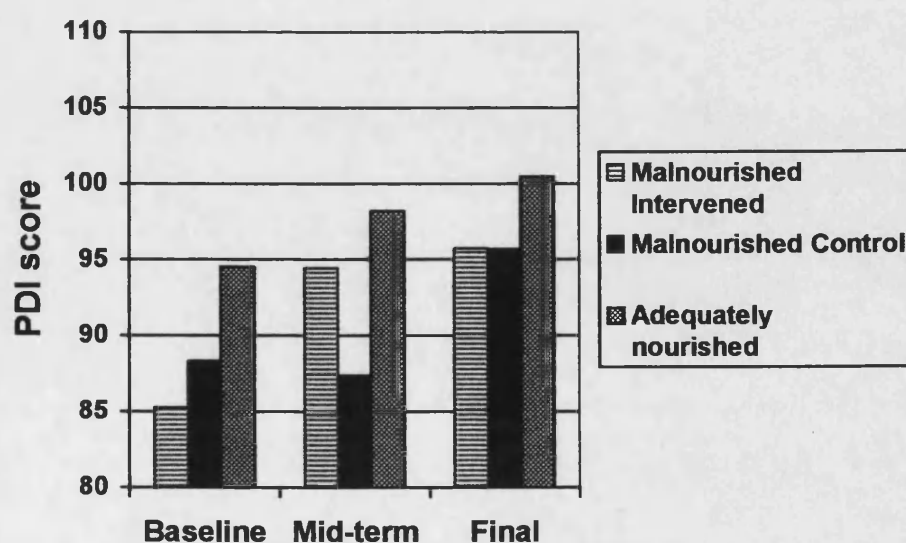
A final explanation could be that the test is not standardized for Bangladesh and that the difficulty of the items across the age range vary somewhat for Bangladeshi children. However, there was a reasonably wide age range among the children.

It is very difficult to be certain as to the explanation and all of the above speculations that could have contributed to the findings.

**Figure 8.1. Mean MDI in the children tested at mid-term by group and the time of assessment**



**Figure 8.2. Mean PDI in the children tested at mid-term by group and time of assessment**



## 7.9. MULTILEVEL ANALYSES

**Table 9.1.**

**Significant regression coefficients (B), standard errors (se), and 95% confidence intervals (95%CI) from regression of final MDI in the multilevel model in intervened (n=92) and control (n=101) malnourished children**

Variables	MDI	
	B (se, 95%CI)	p-value
<b>Fixed parameters</b>		
Baseline scores	0.42 (0.08, 0.26, 0.57)	<0.00001
Age (months)	1.4 (0.27, 0.88, 1.9)	<0.00001
Fathers' education	5.1 (2.0, 1.2, 9.1)	0.01
Treatment	-4.8 (2.0, 0.88, 8.7)	0.02
<b>Random parameters</b>		
Village	0.000 (0.000)	
Child	188.6 (19.2, 151, 226.2)	<0.00001

Model: Predicting final MDI from baseline MDI score, age of child at enrolment, fathers' education (5 years of schooling) and treatment at the levels of village and child. Negative 'B' for treatment means intervention scores were higher than control.

**Table 9.2.**

**Significant regression coefficients (B), standard errors (se), and 95% confidence intervals (95%CI) from regression of final PDI in the multilevel model in intervened (n=92) and control (n=101) malnourished children**

Variables	PDI	
	B (se, 95%CI)	p-value
<b>Fixed parameters</b>		
Baseline scores	0.38 (0.06, 0.26, 0.5)	<0.00001
Age (months)	0.69 (0.25, 0.2, 1.2)	0.005
Fathers' education	5.1 (2.2, 0.76, 9.4)	0.02
Treatment	-3.3 (2.9, -2.4, 9.0)	0.3
<b>Random parameters</b>		
Village	19.55 (13.25, -6.41, 45.51)	0.1
Child	207.99 (22.35, 164.2, 250.8)	<0.00001

Model: Predicting final PDI from baseline score, age, fathers' education (5 years of schooling) and treatment at the levels of village and child. Negative 'B' for treatment means intervention scores were higher than control.

**Table 9.3.**

**Significant regression coefficients (B), standard errors (se), and 95% confidence intervals (95%CI) from regression of final Approach in the multilevel model in intervened (n=92) and control (n=101) malnourished children**

	Approach	
Variables	B (se, 95%CI)	p-value
Fixed parameters		
Baseline scores	0.14 (0.06, 0.02, 0.26)	0.02
Treatment	-4.8 (0.15, -0.8, -0.18)	0.002
Random parameters		
Village	0000 (0.000)	
Child	1.08 (0.1, 0.86, 1.3)	<0.00001

Model: Predicting final Approach from baseline score, age, fathers' education (5 years of schooling) and treatment at the levels of village and child. Negative 'B' for treatment means intervention scores were higher than control.

**Table 9.4.**

**Significant regression coefficients (B), standard errors (se), and 95% confidence intervals (95%CI) from regression of final Emotional tone in the multilevel model in intervened (n=92) and control (n=101) malnourished children**

	Emotional tone	
Variables	B (se, 95%CI)	p-value
Fixed parameters		
Baseline scores	0.09 (0.05, -0.01, 0.19)	<0.07
Age (months)	0.08 (0.02, -0.22, 0.38)	0.5
Treatment	-0.31 (0.15, -0.61, -0.01)	0.04
Random parameters		
Village	0.000 (0.000)	
Child	1.08 (0.1, 0.77, 1.3)	<0.00001

Model: Predicting final Emotional tone from baseline score, age, fathers' education (5 years of schooling) and treatment at the levels of village and child. Negative 'B' for treatment means intervention scores were higher than control.

**Table 9.5.**  
**Significant regression coefficients (B), standard errors (se),**  
**and 95% confidence intervals (95%CI) from regression of final cooperation**  
**in the multilevel model in intervened (n=92) and control (n=101)**  
**malnourished children**

	Cooperation	
Variables	B (se, 95%CI)	p-value
<b>Fixed parameters</b>		
Baseline scores	0.09 (0.05, 0.0.18)	0.07
Age (months)	0.06 (0.02, 0.03, 0.09)	0.0005
Treatment	-0.41 (0.16, -0.71, -0.11)	0.008
<b>Random parameters</b>		
Village	0.000 (0.000)	
Child	1.13 (0.12, 0.9, 1.33)	<0.00001

Model: Predicting final cooperation from baseline score, age, fathers' education (5 years of schooling) and treatment at the levels of village and child. Negative 'B' for treatment means intervention scores were higher than control.

**Table 9.6.**  
**Significant regression coefficients (B), standard errors (se),**  
**and 95% confidence intervals (95%CI) from regression of final Activity in the**  
**multilevel model in intervened (n=92) and control (n=101) malnourished**  
**children**

	Activity	
Variables	B (se, 95%CI)	p-value
<b>Fixed parameters</b>		
Baseline scores	0.24 (0.08, 0.08,0.4)	0.003
Age (months)	-0.04 (0.02, -0.08, 0)	0.05
Treatment	-0.006 (0.2, -0.4, 0.3)	0.9
<b>Random parameters</b>		
Village	0.04 (0.06, -0.08,0.16)	0.5
Child	1.4 (0.15, 1.13, 1.73)	<0.00001

Model: Predicting final Activity from baseline score, age, fathers' education (5 years of schooling) and treatment at the levels of village and child. Negative 'B' for treatment means intervention scores were higher than control.



**Table 9.7.**  
**Significant regression coefficients (B), standard errors (se),**  
**and 95% confidence intervals (95%CI) from regression of final Vocalisation**  
**in the multilevel model in intervened (n=92) and control (n=101)**  
**malnourished children**

	Vocalisation	
Variables	B (se, 95%CI)	p-value
Fixed parameters		
Baseline scores	0.33 (0.07, 0.2, 0.5)	<0.00001
Age (months)	0.08 (0.03, 0.3, 0.13)	0.004
Treatment	-0.45 (0.23, 0.01, 0.9)	0.05
Random parameters		
Village	0.000 (0.000)	
Child	2.4 (0.25, 1.9, 2.9)	<0.00001

Model: Predicting final Vocalization from baseline score, age, fathers' education (5 years of schooling) and treatment at the levels of village and child. Negative 'B' for treatment means intervention scores were higher than control.

**Table 9.8.**  
**Significant regression coefficients (B), standard errors (se),**  
**and 95% confidence intervals (95%CI) from regression of mothers'**  
**knowledge of child rearing in the multilevel model in intervened (n=92) and**  
**control (n=101) malnourished children**

	Mothers' knowledge of child rearing	
Variables	B (se, 95%CI)	p-value
Fixed parameters		
Baseline scores	0.43 (0.07, 0.29, 0.57)	<0.00001
Fathers' education	0.76 (0.49, -0.2, 1.73)	0.1
Treatment	-3.56 (0.54, 2.5, 4.628.7)	<0.00001
Random parameters		
Village	0.35 (0.45, -0.57, 1.27)	0.4
Child	10.5 (1.1, 8.7, 12.7)	<0.00001

Model: Predicting final scores of mothers' knowledge of child rearing from baseline score, age, fathers' education (5 years of schooling) and treatment at the levels of village and child. Negative 'B' for treatment means intervention scores were higher than control.

## **7.10. LIST OF ABBREVIATIONS**

<b>BINP</b>	<b>Bangladesh Integrated Nutrition Programme</b>
<b>BMI</b>	<b>Body Mass Index</b>
<b>BRAC</b>	<b>Bangladesh Rural Advancement Committee</b>
<b>BSID</b>	<b>Bayley Scales of Infant Development</b>
<b>CARE</b>	<b>Cooperative for American Remittances to Europe</b>
<b>CBNC</b>	<b>Community Based Nutrition Component</b>
<b>CCDP</b>	<b>Comprehensive Child Development Programme</b>
<b>CNC</b>	<b>Community Nutrition Centre</b>
<b>CNP</b>	<b>Community Nutrition Promoters</b>
<b>CNS</b>	<b>Central Nervous System</b>
<b>CEE</b>	<b>Central and Eastern Europe</b>
<b>CEFT</b>	<b>Children's Embedded Figure Test</b>
<b>CIS</b>	<b>Commonwealth of Independent States</b>
<b>DfID</b>	<b>Department for International Development</b>
<b>DQ</b>	<b>Development Quotient</b>
<b>ECCD</b>	<b>Early Childhood Care and Development</b>
<b>ECD</b>	<b>Early Childhood Development</b>
<b>FGD</b>	<b>Focus Group Discussion</b>
<b>ICDDR,B</b>	<b>International Centre for Diarrhoeal Disease Research, Bangladesh</b>
<b>ICDS</b>	<b>Integrated Child Development Services</b>
<b>ICMH</b>	<b>Institute of Child and Mother Health</b>
<b>IHDP</b>	<b>Infant Health and Development Programme</b>
<b>INCAP</b>	<b>Institute of Nutrition of Central America and Panama</b>
<b>IQ</b>	<b>Intelligence Quotient</b>
<b>IUGR</b>	<b>Intra uterine growth retardation</b>
<b>GCI</b>	<b>General Cognitive Index</b>
<b>GNP</b>	<b>Gross National Product</b>
<b>HFA</b>	<b>Healthy Families America</b>
<b>HIPPY</b>	<b>Home Instruction Programme for Preschool Youngsters</b>
<b>HOME</b>	<b>Home Observation for Measurement of Environment</b>
<b>HW</b>	<b>Health Worker</b>

<b>LBW</b>	<b>Low Birth Weight</b>
<b>MDI</b>	<b>Mental Development Index</b>
<b>MPC</b>	<b>Mental Processing Composite</b>
<b>MT</b>	<b>Mother Training</b>
<b>MUAC</b>	<b>Mid Upper Arm Circumference</b>
<b>NBW</b>	<b>Normal Birth Weight</b>
<b>NCDCA</b>	<b>National Committee to Prevent Child Abuse</b>
<b>NCHS</b>	<b>National Centre for Health Statistics</b>
<b>NGO</b>	<b>Non-Government Organizations</b>
<b>NHVP</b>	<b>Nurse Home Visitation Programme</b>
<b>NMT</b>	<b>No Mother Training</b>
<b>NNP</b>	<b>National Nutrition Programme</b>
<b>PAT</b>	<b>Parents as Teachers</b>
<b>PEM</b>	<b>Protein Energy Malnutrition</b>
<b>PDI</b>	<b>Psychomotor Development Index</b>
<b>PL</b>	<b>Play Leader</b>
<b>PPVT</b>	<b>Peabody Picture Vocabulary Test</b>
<b>RCT</b>	<b>Randomised Controlled Trial</b>
<b>SD</b>	<b>Standard Deviation</b>
<b>SES</b>	<b>Socio-Economic Status</b>
<b>UK</b>	<b>United Kingdom</b>
<b>USA</b>	<b>United States of America</b>
<b>UNICEF</b>	<b>United Nation's International Children Emergency Fund</b>
<b>WHO</b>	<b>World Health Organisation</b>
<b>WIC</b>	<b>Women, Infant and Children</b>
<b>WISC</b>	<b>Weschler Intelligent Scale for Children</b>
<b>WISC-R</b>	<b>Weschler Intelligent Scale for Children-revised</b>
<b>WPPSI</b>	<b>Weschler Preschool and Primary Scale of Intelligence</b>
<b>WRAT</b>	<b>Wide Range Achievement Test</b>